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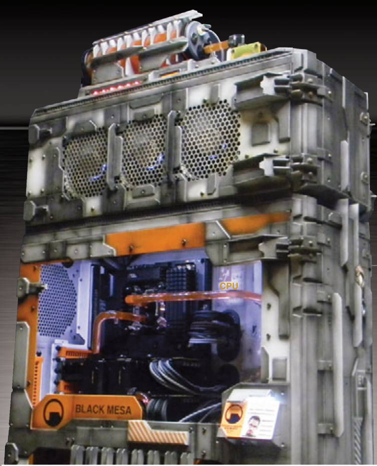

HALF-LIFE BLACK MESA
HAF STACKER MOD WINS PDXLAN

AMD
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May | Vol. 14 Iss. 05
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4770 3.40Ghz	$ 999
Intel® Core™ i5 Processor	
4670K 3.40Ghz	$ 929
4670 3.40Ghz	$ 899
4570 3.20Ghz	$ 975
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4570 3.20Ghz	$ 1155
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7.9 Lbs | 8X±RW | 4in1 Media Reader | Built-in

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FANGBOOK EVO HX7-300

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HDMI | IEEE 1394 | USB 3.0 | 2 hr
7.9 Lbs | 14X | 4in1 Media Reader | Built-in

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4810MQ	$2009
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Monthly last-page interview with people who help to shape the PC industry.

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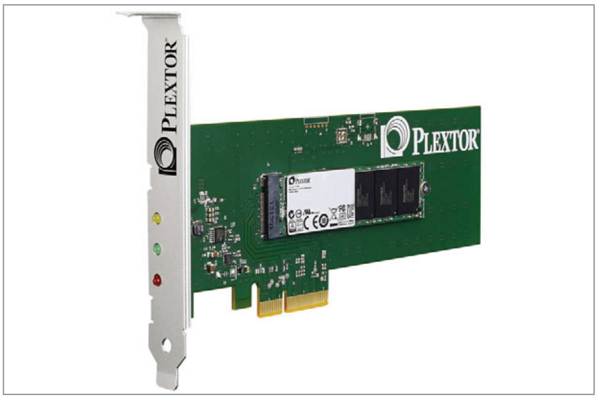
Silicon Mechanics Scales K40

Server and HPC company Silicon Mechanics recently announced that it has added NVIDIA's Tesla K40 GPU accelerator to its GPU Solutions product line. NVIDIA calls the Tesla K40 "the world's fastest accelerator" for GPU compute applications, such as big data analytics and high-end scientific computations. The K40 is based on NVIDIA's Kepler GPU architecture and boasts 12GB of GDDR5, 2,880 CUDA parallel processing cores, and PCIe Gen-3 interconnect support. As a result, it provides up to 40% higher performance than its predecessor, the Tesla K20X GPU accelerator. Silicon Mechanics provides an NVIDIA Test Drive program that allows potential customers to log in to a remote server equipped with four Tesla K40 GPUs and run their own compute apps in order to demonstrate the performance their systems will deliver (sign up at www.siliconmechanics.com).

Plextor Cranks It Up With The M6E Internal PCI Express SSD

Gamers looking for a little extra speed will enjoy using Plextor's new M6E Internal SSD. The company has optimized the SSD for gaming and says the drive is the "first PCI Express SSD optimized for professional gamers." (So you better pick up your game if you want to use this drive, slackers.) The drive sports a Marvell 88SS9183 dual-core controller and Toshiba toggle mode NAND flash memory, and offers maximum sequential read/write speeds of 770/625 MBps and random read/write speeds of 105K/100K IOPS. The M6E also supports UEFI as well as legacy BIOSes. With a five-year warranty and stated MTBF of 2.4 million hours, this one should be a staple in your system for a long time. Sizes available are 128GB, 256GB, and 512GB.



WATCHING THE CHIPS FALL

Here is the pricing information for various AMD and Intel CPUs.

CPU	Released	Original Price	Last Month's Price	Online Retail Price*
AMD FX-9590 Eight-Core	6/11/2013	NA	$299.99	$329.99
AMD FX-9370 Eight-Core	6/11/2013	$375	$249.99	$229.99
AMD FX-8350 Eight-Core	10/23/2012	$195	$199.99	$199.99
AMD FX-8320 Eight-Core	10/23/2012	$169	$159.99	$159.99
AMD FX-6350 Six-Core	4/30/2013	$132	$129.99	$139.99
AMD A10-6800K Quad-Core	6/4/2013	$142**	$139.99	$129.99
AMD A10-6790K Quad-Core	10/28/2013	$130	$119.99	$129.99
AMD A10-6700 Quad-Core	6/4/2013	$142**	$148.99	$148.99
AMD A8-6600K Quad-Core	6/4/2013	$112**	$119.99	$109.99
AMD A8-6500 Quad-Core	6/4/2013	$112**	$118.99	$104.99
Intel Core i7-4960X Extreme Edition	9/3/2013	$990**	$1,049.99	$1,049.99
Intel Core i7-4930K	9/3/2013	$583**	$579.99	$579.99
Intel Core i7-4770K	6/2/2013	$339**	$339.99	$339.99
Intel Core i7-4820K	9/3/2013	$323**	$324.99	$324.99
Intel Core i7-4770	6/2/2013	$303**	$309.99	$309.99
Intel Core i5-4670K	6/2/2013	$242**	$239.99	$229.99
Intel Core i5-4670	6/2/2013	$213**	$219.99	$219.99
Intel Core i5-4570	6/2/2013	$192**	$199.99	$199.99
Intel Core i5-4430	6/2/2013	$182**	$189.99	$189.99
Intel Core i3-4340	9/1/2013	$149**	$159.99	$159.99

* As of April 2014
** Manufacturer's estimated price per 1,000

Deepcool Quanta DQ1250 Gives Your System The Power It Needs

Deepcool is coming out with a new high-end power supply aimed at gamers and power users. The Quanta DQ1250 is a 1250W PSU with two 12V rails (one 45A and one 65A) that is 80 Plus Platinum-certified. The PSU has a low-noise, 140mm zero-RPM fan that won't spin at 30% or lower load or if the temp is under 25 degrees Celsius. The fan also is programmed to run a few seconds (up to half a minute) after each system shutdown to help cool off components. An extensive set of flat modular power cables comes with the PSU, so you can select just what you need and avoid having excess cables blocking airflow or cluttering up your case. Deepcool says there's also a double-layer EMI filter in the PSU to help block electromagnetic interference.

MSI Stakes Out New Ground With The Mini-ITX AM1I

MSI, one of the leading global manufacturers for motherboards, has announced its first board sporting the AM1 socket. The Mini-ITX AM1I supports up to 32GB of DDR3 1333/1600 (two slots), has 2 x USB 3.0 ports (rear) and 6 x USB 2.0 ports (four in front), has one PCIe x 16 slot and one mini-PCIe slot, and has 4 x SATAIII ports. The mobo also supports 4K UHD and is equipped with HDMI, DVI, and D-Sub outputs, as well as Gigabit Ethernet. MSI says the board has met Military Class 4 specifications, which means it should provide better stability and operate better under more extreme conditions (heat, humidity, etc.). Bundled software includes MSI Fast Boot (for faster start times) and Live Update 5 (for updating BIOS and drivers).

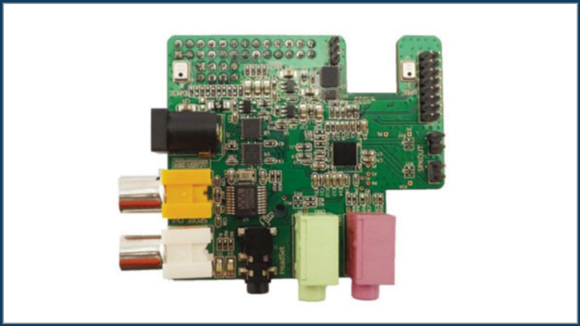
COUGAR Creates Award-Winning Mouse & Keyboard For Gamers

Computer chassis and peripherals manufacturer COUGAR spent two years working on the design of the 700 series aluminum mouse and keyboard (700m and 700k, respectively), and it shows. Both products recently won prestigious iF (International Forum) Design awards for 2014. The 8,200dpi mouse was designed to be very responsive and features a 45-degree side angle sniper button that Cougar says improves accuracy because it requires less lateral force to use. The cable connector resembles a rifle muzzle, appropriate for a mouse designed for FPS gaming, and the mouse can be configured as desired for ergonomic comfort. Inspiration for the 700K keyboard came from stealth warships; the keyboard has mechanical keys on an aluminum frame with special anodized surface treatments and support points for the wrists. Pricing on the 700 mouse and keyboard series was not available as we went to press, but both products should be released soon.

EVGA Powers Up Its G2 Line With Two New PSUs: The 850 & 750

EVGA has rolled out two new additions to its G2 line of SuperNova power supplies aimed at enthusiasts. The 850 (shown at left) and 750 watt units are high-amp, single-rail products that are SLI-ready and fully modular. Both units have double-ball-bearing fans and offer EVGA's ECO Thermal Control Fan system, which provides various running modes that will reduce fan noise or even eliminate it during low-load operations when the system is under 45 degrees Celsius. EVGA says the PSUs are built to operate continuously at their stated output, and that they are constructed with the highest-quality solid-state capacitors from Japan. Both PSUs have a rated mean time between failure of 100,000 hours and come with a 10-year warranty. The MSRP for the 750W G2 is $129.99; the 850W G2 runs $159.99.

HARDWARE MOLE

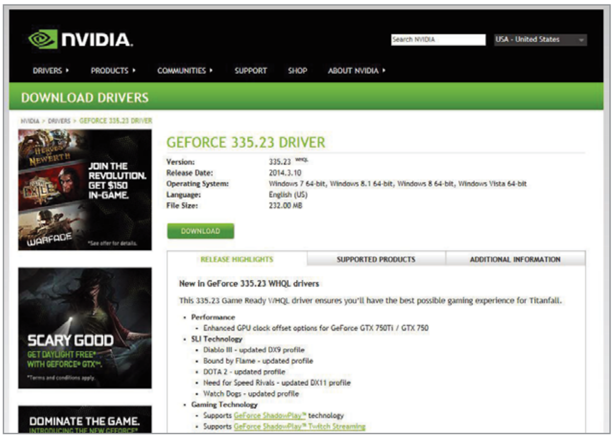


Hear That? It's A Big Slice Of Sound For Raspberry Pi

Element 14, the makers (bakers?) of the popular Raspberry Pi micro computer system, have collaborated with audio company Wolfson to offer the Wolfson Audio Card to the growing community of Pi users. The inexpensive sound card (about $34) provides a way for Pi users to capture audio and also experiment with sound in general on their Pi. The card has 3.5mm jacks for a headset and for a stereo output line (so you can connect powered speakers, for example), an onboard microphone, and S/PDIF input and output. Element 14 says the card is capable of rendering 24-bit HD Audio. For more info, go to www.element14.com and look under the Raspberry Pi Accessories topic.

D-Link Offers Up The World's First 11AC Portable Router

D-Link is now shipping what it claims is the world's first portable 802.11ac router: the DIR-510L Wi-Fi AC750 Portable Router and Charger. The product lets travelers quickly create a mobile Wi-Fi hotspot from various types of Internet connections (Wi-Fi, 3G/4G, Ethernet). You can share Internet access from your phone to your other devices or with other people in your traveling party. But wait, there's more: the AC750 also pulls double duty as a charger for phones and other mobile products due to its high-capacity rechargeable battery. The device has a USB port so you can access and share files from a thumb drive, too. It has an MSRP of $99.99.



GEFORCE 335.23 DRIVER

Version: 335.23 WHQL
Release Date: 2014.3.10
Operating System: Windows 7 64-bit, Windows 8.1 64-bit, Windows 8 64-bit, Windows Vista 64-bit
Language: English (US)
File Size: 232.00 MB

New in GeForce 335.23 WHQL drivers

This 335.23 Game Ready WHQL driver ensures you'll have the best possible gaming experience for Titanfall.

- Performance
  - Enhanced GPU clock offset options for GeForce GTX 750Ti / GTX 750
- SLI Technology
  - Diablo III - updated DX9 profile
  - Bound by Flame - updated profile
  - DOTA 2 - updated profile
  - Need for Speed Rivals - updated DX11 profile
  - Watch Dogs - updated profile
- Gaming Technology
  - Supports GeForce ShadowPlay™ technology
  - Supports GeForce ShadowPlay™ Twitch Streaming

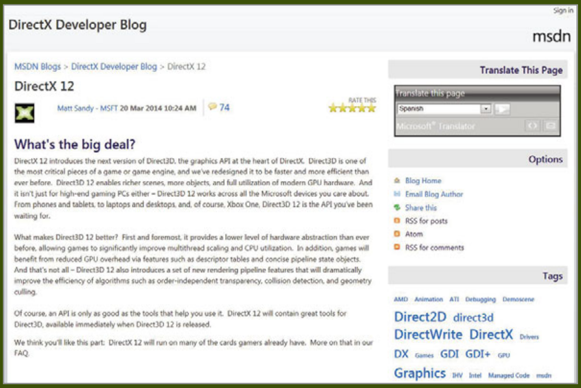
Hey, Pilot: Nvidia Releases Driver Optimized For Titanfall

If your system sports cards from Big Green and you're playing Titanfall, you may want to head over to www.geforce.com to download the new GeForce 335.23 WHQL driver. Nividia has optimized the new driver specifically for Respawn's hit game and says that the "335.23 Game Ready WHQL driver ensures you'll have the best possible gaming experience for Titanfall." You'll also get some other benefits, of course, including new SLI profiles for other games (Diablo III, DOTA 2, Bound By Flame, Need For Speed Rivals, and Watch Dogs) and 3D Vision profiles for Titanfall, Thief, and Call of Duty: Ghosts. The driver also has improved GPU clock offset options for the GeForce GTX 750 and 750 Ti.

Apple CarPlay Is Ready To Roll

Apple is partnering with car manufacturers to provide a new (and safer) way for drivers to use their iPhones while traveling. CarPlay relies heavily on Siri, Apple's voice assistant, to make various features and apps for iOS available while driving. Productivity and entertainment both loom large, as drivers can get directions from Maps, access contact lists and make phone calls, request specific artists and listen to music, and have their email messages read to them. Apple also says that drivers in CarPlay-equipped vehicles will be able to operate CarPlay using the physical buttons (steering wheel mutes, for example) or touchscreens already in their cars. CarPlay is now available from several car makers including Ferrari, Volvo, Mercedes-Benz, Honda, and Hyundai, and will be rolling out in models from GM, Ford, BMW, Jaguar, and many other manufacturers soon.

SOFTWARE SHORTS



DirectX 12

Matt Sandy - MSFT 20 Mar 2014 10:24 AM 74

What's the big deal?

DirectX 12 introduces the next version of Direct3D, the graphics API at the heart of DirectX. Direct3D is one of the most critical pieces of a game or game engine, and we've redesigned it to be faster and more efficient than ever before. Direct3D 12 enables richer scenes, more objects, and full utilization of modern GPU hardware. And it isn't just for high-end gaming PCs either – Direct3D 12 works across all the Microsoft devices you care about. From phones and tablets, to laptops and desktops, and, of course, Xbox One, Direct3D 12 is the API you've been waiting for.

What makes Direct3D 12 better? First and foremost, it provides a lower level of hardware abstraction than ever before, allowing games to significantly improve multithread scaling and CPU utilization. In addition, games will benefit from reduced GPU overhead via features such as descriptor tables and concise pipeline state objects. And that's not all – Direct3D 12 also introduces a set of new rendering pipeline features that will dramatically improve the efficiency of algorithms such as order-independent transparency, collision detection, and geometry culling.

Of course, an API is only as good as the tools that help you use it. DirectX 12 will contain great tools for Direct3D, available immediately when Direct3D 12 is released.

We think you'll like this part: DirectX 12 will run on many of the cards gamers already have. More on that in our FAQ.

Coming Later To A LAN Near You: Microsoft DirectX12

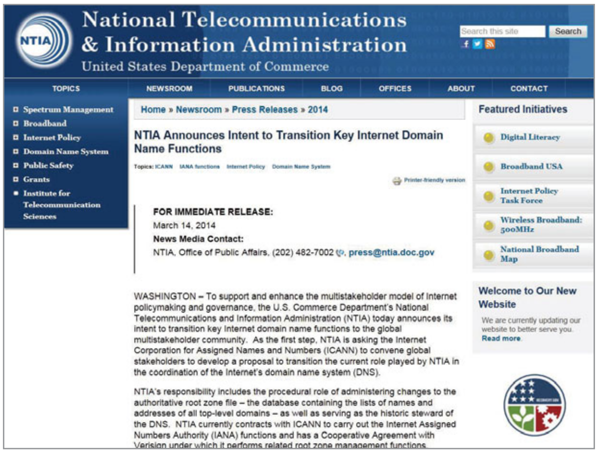
Microsoft recently announced there would be an updated release for DirectX, its specification for a collection of gaming APIs that makes it easier for developers to program games for Windows. The big news in the announcement was that DirectX12 will, for the first time, give developers low-level access to graphics programming. This is welcome news for gamers, as it will make it possible for developers to take full advantage of the performance capabilities of the latest PC hardware, which means more responsive gaming and better-looking games. You can read more about the nuances of DirectX12 at this bitmark for the DirectX Developer Blog: bit.ly/1mr2Fws.

ASRock + Kloudian = ASRock Cloud

Motherboard manufacturer ASRock has partnered with cloud services provider Kloudian to make a personal cloud service available to its customers. The "ASRock Cloud" is basically a rebranded three-year subscription to Orbweb.ME Professional, Kloudian's service, that ASRock customers can use for free. Normally the service runs $49.99 annually. There's also a free one-month trial of the Orbweb.ME Ultimate service, which includes remote desktop capabilities. All you have to do to use the new ASRock Cloud service is download the free software and then enter the promotional code "ASRock2014" (remember, ASRock says the service is only available to its motherboard customers). You'll be able to remotely turn on your PC and then stream or transfer files. You also can use the service to send photos or videos from your mobile devices back to your home system.

Anybody Want To Run The DNS?

The U.S. government has decided it is time to get out of the Internet domain name biz. That is, it no longer wants to have primary responsibility for coordinating everything having to do with the Internet's domain name system. While the actual decision to transition away from governmental authority over the DNS was made back in 1997 when the government said it wanted to privatize the system, only recently have steps been taken to make that happen. Timing is everything, of course, and some pundits believe the public furor over the NSA's collection of phone calls may have something to do with the recent announcement from the office of the NTIA (National Telecommunications & Information Administration). You can view the announcement at 1.usa.gov/1dUAeBZ.



NTIA Announces Intent to Transition Key Internet Domain Name Functions

Topics: ICANN IANA functions Internet Policy Domain Name System

FOR IMMEDIATE RELEASE:
March 14, 2014
News Media Contact:
NTIA, Office of Public Affairs, (202) 482-7002, press@ntia.doc.gov

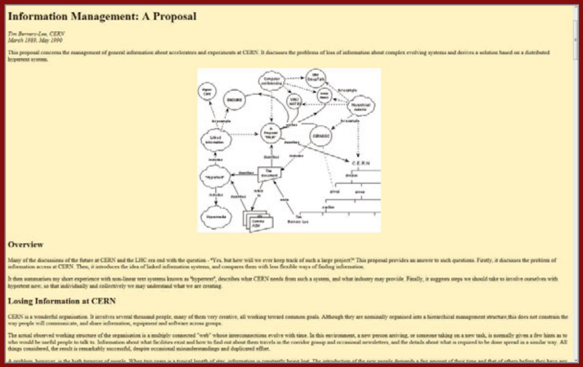
WASHINGTON – To support and enhance the multistakeholder model of Internet policymaking and governance, the U.S. Commerce Department's National Telecommunications and Information Administration (NTIA) today announces its intent to transition key Internet domain name functions to the global multistakeholder community. As the first step, NTIA is asking the Internet Corporation for Assigned Names and Numbers (ICANN) to convene global stakeholders to develop a proposal to transition the current role played by NTIA in the coordination of the Internet's domain name system (DNS).

NTIA's responsibility includes the procedural role of administering changes to the authoritative root zone file – the database containing the lists of names and addresses of all top-level domains – as well as serving as the historic steward of the DNS. NTIA currently contracts with ICANN to carry out the Internet Assigned Numbers Authority (IANA) functions and has a Cooperative Agreement with Verisign under which it performs related root zone management functions.

Welcome to Our New Website

We are currently updating our website to better serve you. Read more

SITE SEEING



Information Management: A Proposal

Tim Berners-Lee, CERN
March 1989, May 1990

This proposal concerns the management of general information about accelerators and experiments at CERN. It discusses the problems of loss of information about complex evolving systems and derives a solution based on a distributed hypertext system.

Overview

Many of the discussions of the future at CERN and the LHC era end with the question - "Yes, but how will we ever keep track of such a large project?" This proposal provides an answer to such questions. Firstly, it discusses the problem of information access at CERN. Then, it introduces the idea of linked information systems, and compares them with less flexible ways of finding information.

It then summarises my short experience with non-linear text systems known as "hypertext", describes what CERN needs from such a system, and what industry may provide. Finally, it suggests steps we should take to involve ourselves with hypertext now, so that individually and collectively we may understand what we are creating.

Losing Information at CERN

CERN is a wonderful organisation. It involves several thousand people, many of them very creative, all working toward common goals. Although they are nominally organised into a hierarchical management structure,this does not constrain the way people will communicate, and share information, equipment and software across groups.

The actual observed working structure of the organisation is a multiply connected "web" whose interconnections evolve with time. In this environment, a new person arriving, or someone taking on a new task, is normally given a few hints as to who would be useful people to talk to. Information about what facilities exist and how to find out about them travels in the corridor gossip and occasional newsletters, and the details about what is required to be done spread in a similar way. All things considered, the result is remarkably successful, despite occasional misunderstandings and duplicated effort.

Happy Birthday, World Wide Web! You Don't Look A Day Over . . . 25

This year the World Wide Web celebrates its 25th birthday (yup, we find it hard to believe, too). The birth date derives from the original conceptual paper that computer scientist Tim Berners-Lee submitted to his managers at CERN to create a global information management system he called the "Mesh" (and that he later renamed the World Wide Web when he was writing the original code). The text and illustrations of that document have been posted online by Berners-Lee for posterity. You can view them here: www.w3.org/History/1989/proposal.html.

Job Of The Month

Internships are not only a time-honored way of checking out a potential field of interest or company, they're also a good way to let a company check out *you.* If you're a Comp Sci or EE graduate student who's looking for an internship that will give you some good experience as well as put some nice dressing on your resume salad, you may want to check out this opening at Intel. The mother of all things processor is looking for a software development intern for its Virtual Prototype Center of Expertise group. This person will research a variety of problems and scenarios and work on "improving infrastructure and delivering production-worthy tools and flows." Yeah, it's a little open-ended, but hey, you don't want to be boxed in, right? You'll learn all about software and hardware modeling techniques and will work on creating automation tools that "speed up the development of Hybrid infrastructure solutions." In other words, you'll help make the stuff that makes the stuff at Intel, and be on the cutting edge of the cutting edge. This particular opening is in their Phoenix, Ariz., plant. Just don't forget the donuts, intern.

Source: jobs.intel.com

So, Siri . . . Uh, What Are You Doing This Evening?

Voice assistants, software that acts as virtual concierges for phone and tablet users, are very busy these days. The best known are Apple's Siri and Google Now, but Microsoft recently announced it was getting into the act, too, with a new tool called Cortana (named after a Halo character that serves a similar role in the game). People tend to interact a little differently with digital devices when they use a voice assistant. A recent study on phone interactions by voice platform company PlexiNLP found that 25% of queries to voice assistants were attempts to interact with the sofware's persona. See other types of interactions listed at right.

Source: PlexiNLP.com

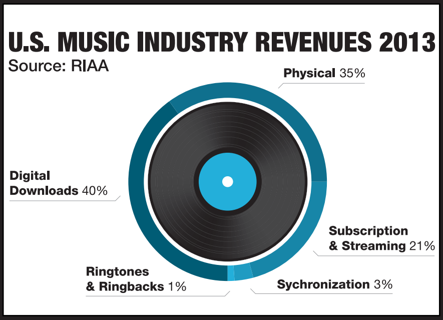
Types Of Phone Interactions

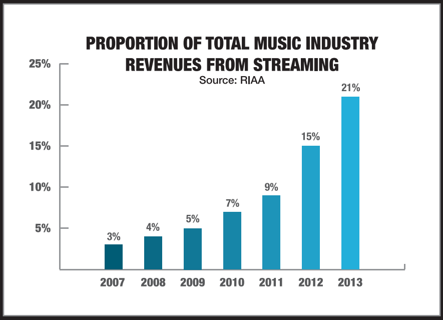
Interact with personality	25%
Ego statements	15%
General information requests	9%
App interaction	8%
Weather	6%
Definitions	6%
Directions	4%
Geopolitical information	4%
Alarms/calendars	3%
Ask about date/time	3%
Make a call	2%
Send a text	2%
OTHER**	14%

**Includes contact lookup, device status, math, image search, sports, music, movies, how-tos, stocks, news, translations, email, and local info.

Streaming Up, Up, Up; Other Music Sales Down

A study of U.S. music industry revenues by the RIAA (Recording Industry Association of America) shows that fast-growing digital streaming revenues are helping to offset a continuing slide in sales of physical media, as overall music revenues in 2013 were nearly flat with the previous year. The portion of music sales driven by streaming is growing rapidly and now accounts for about 21% of all music revenues.





RAW Numbers:

1

Number of seconds it will take to download a full-length movie using 5G (5th Generation) networks. South Korea is planning to have a 5G network operational by 2020 and says it should be about 1,000 times faster than current 4G networks.

AFP Report

36%

Percentage of the U.S. population over age 13 who play digital games. Some 90% of those gamers play primarily on a computer as opposed to a mobile device or a gaming console.

The NPD Group

500,000

Number of wireless home monitoring devices that are forecast to be installed globally and connected to the Internet by 2018.

ABI Research

639,800

Number of gigabytes of data transferred over the global Internet every 60 seconds. (This is equivalent to 639.8 terabytes. The books in the Library of Congress have been estimated to represent about 10 terabytes of data, so to put this another way, an amount of information roughly equivalent to the print collection in the Library of Congress is transmitted over the Internet every second.)

Intel

1 million

Number of 4K TVs that shipped globally during the fourth quarter of 2013. This compares with the 600,000 sets that shipped during Q1 thru Q3.

NPD DisplaySearch

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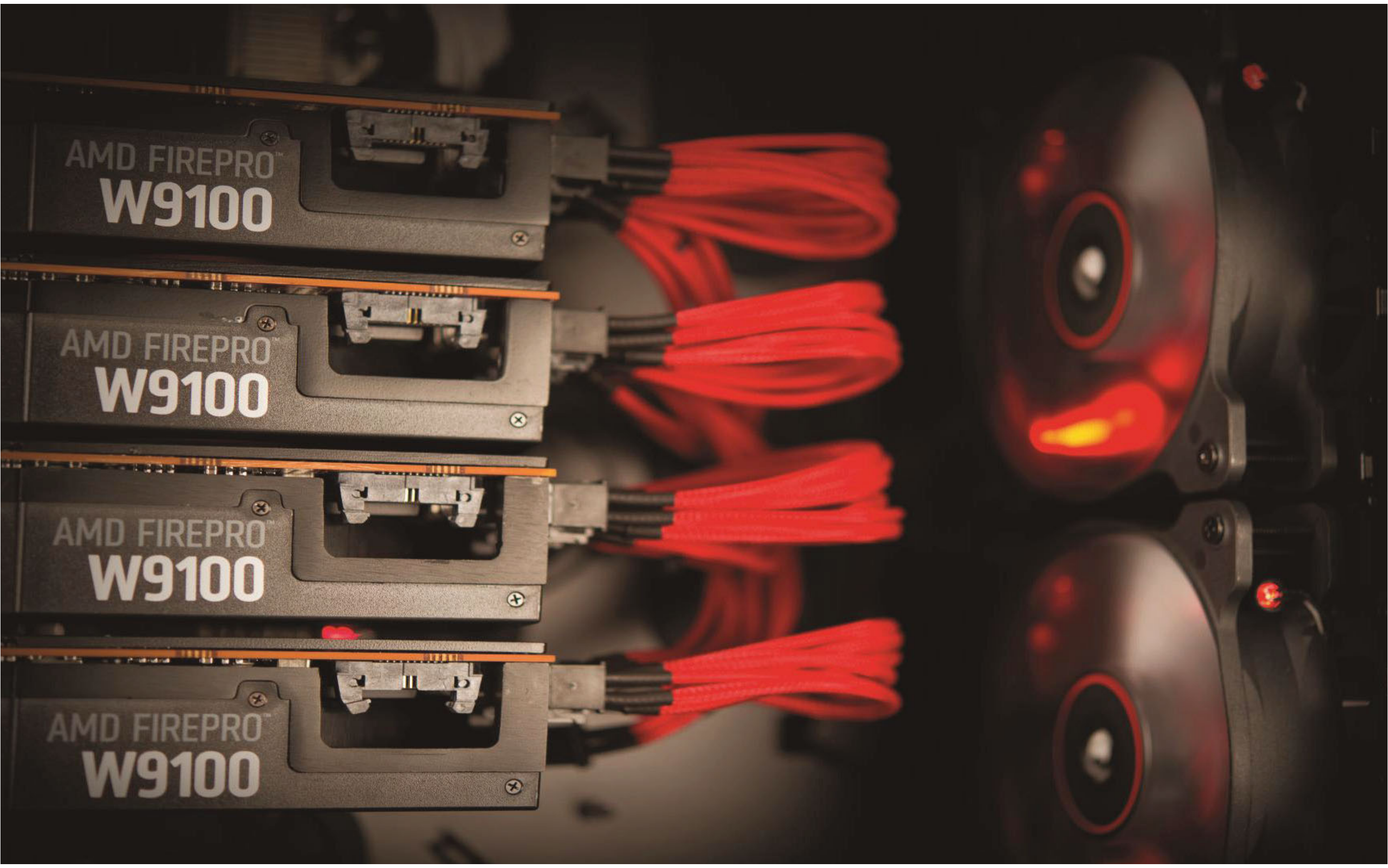
AMD FirePro W9100

Transforming The Workstation



The use of GPUs to perform high-end compute workloads has exploded in recent years. Their parallel nature and access to large amounts of fast memory make them well-suited to compute-intensive engineering operations such as 3D design, simulation, and visualization, as well as content creation tasks like capturing high-definition media, rendering objects in 3D, adding visual effects, and encoding video. And now, with 4K video becoming an integral part of professional workflows, the need for serious GPU compute power is greater than ever.

The AMD FirePro W9100 fills that need through cutting-edge design, massive compute horsepower, and OpenCL 2.0 support.

Engineered For Greatness

Since its inception, AMD's GCN (Graphics Core Next) architecture has proven especially adept where compute applications are concerned. As such, it was a natural fit when the company first built GCN-based graphics processors into its professional graphics product line in 2012, with the introduction of its W8000 and W9000 FirePro cards.

The GCN architecture is simpler to work with than prior graphics tools from assembly to debug, ensuring that more compute cycles translate directly to performance. Add to this the inclusion of AMD's Mantle API, which among other things provides more efficient communication between the GPU and CPU, and the bottom line is more effective multitasking and less time spent waiting for compute tasks to complete.

Compute Muscle

If its GCN architecture and Mantle API make FirePro W9100 a multi-Ph.D.

Advertisement

genius, its raw computing power makes it a world-class bodybuilder, as well. FirePro W9100 is the first workstation graphics card to boast a staggering 16GB of on-board GDDR5 memory, and it provides bandwidth greater than 300GBps. As a result, FirePro W9100 is capable of producing well over 2 TFLOPS of double-precision GPU compute performance, and more than 5 TFLOPS of single-precision GPU compute performance.

Each FirePro W9100 is capable of driving as many as six 4K displays, and AMD made sure that the card's performance scales well in implementations of up to four cards. Looking for a workstation card that will let you blow through 4K video production and color correction? Check. Need to design and run complex simulations simultaneously? FirePro W9100 is ready to go.

And It Plays Nice

All the compute power in the world is useless if you can't quickly and efficiently apply it to the task at hand. Years ago when GPU computing first began to emerge, the challenge was to find the specific applications that were optimized to work with your workstation's GPU(s). OpenCL changed all of that by providing an open, readily accessible set of tools that developers could use to make their applications work across a variety of platforms, including traditional CPUs, GPUs, and more. OpenCL has garnered extensive support among leading software developers including Autodesk, Adobe, The Foundry, MAXON, and many others, which means that the FirePro W9100 enjoys seamless compatibility with the world's most powerful professional-grade software tools.

Transformed

Whether you rely on your workstation to power through CAD/CAE/CAM, digital video production, 4K color correction, 3D rendering and visualization, or any one of numerous other compute-intensive tasks, the AMD FirePro W9100 can make you more productive by dramatically reducing the time it takes your system to complete those tasks. ■

TBS Technologies Matrix

TBS Technologies is known primarily as a manufacturer of digital TV tuners that you can add to your PC. With the Matrix, TBS is branching out to the single-board PC market. Priced at $149.99, the Matrix can work with the TBS' USB TV tuners (as you might guess) to extend its functionality as an HTPC. It's capable of running Android and Ubuntu, too, and that's only the beginning of the big things this little machine can do.

TBS provides links on its website for the Matrix's compatible OS images, so you can install the one that best matches your needs. To function as a full-fledged HTPC, the Matrix supports open-source media center utilities, such as XBMC and VDR.

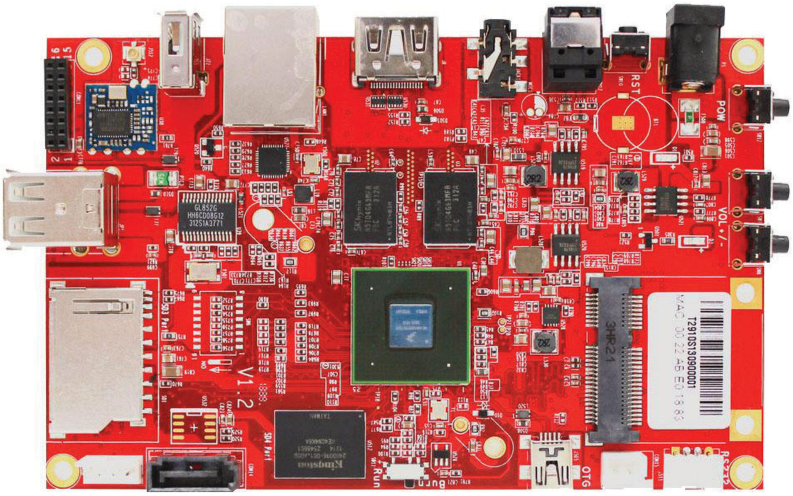
TBS uses a clear acrylic case to enclose the Matrix's single-board system. Openings are cut into the acrylic for the various I/O ports, power inputs, and system buttons. Each port is labeled, and the precise cuts give the Matrix a professional look. There's a vent directly above the heatsink/fan CPU cooler to exhaust hot air from the processor, as well as a bottom intake vent where cool air can enter the case.

The Matrix is powered by a Freescale i.MX6 system-on-a-chip that consists of a quad-core 1GHz ARM Cortex-A9 CPU and a quad-core Vivante GC2000 for graphics processing. There's 2GB of memory and 16GB of eMMC storage. The latter is where you'll install the operating system and applications. You can expand the storage capacity by connecting a hard drive or SSD to Matrix's SATA port. You can't install an OS to a drive connected via the Matrix's SATA port, but the option to add mass storage can nonetheless be a convenient way to store and access large multimedia collections. (There isn't room inside the Matrix for the SATA drive, so getting an external enclosure might not be a bad idea.) Adding a TV tuner to the mix also means that the Matrix can use a connected drive for PVR storage. To power the SATA drive, TBS provides a floppy-to-SATA adapter cable that you can connect to the 4-pin floppy connector on the motherboard.

TBS designs the Matrix with lots of connectivity. To start, there are three USB 2.0 ports, one of which you can use for a TV tuner. Many TBS USB tuners come with a remote control that you can use to navigate a media center environment. There's also a mini PCI-E slot where you can install mini PCI-E devices supported on Linux, such as an HD video decoder. A full-sized SD card slot provides yet another way to expand the Matrix's storage capacity. If you open the case, you'll also find a microSD card slot on the reverse side of the board. For networking, the Matrix has built-in 802.11b/g/n and a Gigabit Ethernet port.

To deliver video and audio to a monitor or HDTV, the Matrix features an HDMI port. In our testing, the Matrix's HDMI output supported resolutions up to 1,920 x 1,080. TBS also offers an optical S/PDIF output and 3.5mm analog output to let you connect the Matrix to an A/V receiver or a pair of headphones, respectively.

Would it surprise you to know that, by default, the Matrix runs TBS' MatrixTV OS? It's a customized Linux distribution based on VDR and XBMC that's designed for HTPC use. We like that it can offer live TV capabilities when the Matrix is paired with a TV tuner. If you want to switch to Android or Ubuntu, burning an OS onto the unit is a relatively easy process. One thing you'll need is a USB mini cable (Mini B), as it's necessary to connect the Matrix to a PC and upload the OS into the Matrix's eMMC memory. We were able to use a mini-USB-to-USB cable that came with our Android phone to do the job.



Benchmark Results	TBS Technologies Matrix
3DMark (Ice Storm Unlimited)	**3460**
Graphics Score	3070
Physics Score	6175
Graphics Test 1	17.9fps
Graphics Test 2	10.7fps
Physics Test	19.6fps

TBS indicates that you'll want to start the installation by downloading your preferred OS from the company's website. Extract the ZIP file to a folder on your PC. Next, toggle the Burn/Run switch on the motherboard to Burn. Now, you can connect the mini USB cable to the USB OTG port on the Matrix and a USB port on a Windows PC. Power on the Matrix and open the file "MfgTool2" in the OS image folder on your PC. The MfgTool2 application should find the Matrix, and when it does, click Start. It'll take a few minutes to install the OS. When finished, you can turn off the Matrix, flip the Burn/Run switch to Run, and the Matrix is ready for its newly installed OS.

The default MatrixTV OS is certainly easy to use. The interface has sections for Video, Music, Pictures, and TV. MatrixTV quickly found the media stored on a connected SATA hard drive, an SD card, and a USB flash drive. The TV function make it easy to time-shift shows. We were able to use the built-in electronic program guide and recording schedule to find and record the shows we wanted to watch. XBMC, VDR, TVheadend, MuMuDVB, and DVBlast are pre-installed on MatrixTV.

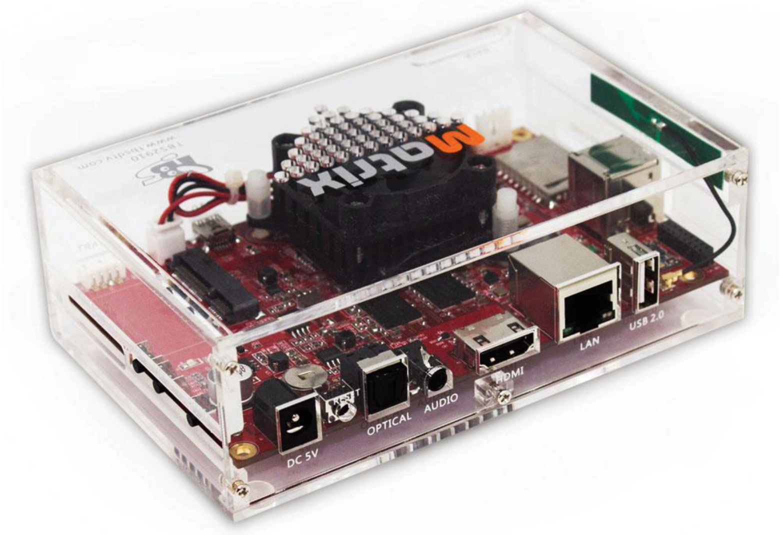
We also installed Android 4.2.2 onto the Matrix. The OS is just like you'd experience on a tablet or smartphone (minus the touchscreen, in our case), and it has access to the Google Play store catalog. XBMC also offers an Android app, so you can enjoy much of the MatrixTV media center functionality in an Android environment.

To test the Matrix, we ran 3DMark's Ice Storm Unlimited test. The Matrix produced an overall score of 3460 and a Graphics Score of 3070. In Ice Storm's graphics tests, the Matrix delivered fps rates of 17.9 and 10.7.

The Matrix certainly has an intriguing mix of hardware for an HTPC. In particular, we liked the ability to install a SATA hard drive. When you combine the Matrix with a TV tuner and a hard drive, you have everything you need for a capable PVR. We also liked that TBS provides several ways to transfer multimedia content to and from the device. The flexibility to run Android and Ubuntu also makes it viable for everyday use, should you want a miniature computer for the office or around the house (or anywhere). The Matrix explores the space without taking up much of it. ■

BY NATHAN LAKE

Matrix
$149.99
TBS Technologies
www.tbstec.com



Specs: Processor: ARM Cortex-A9 @ 1.0GHz; Graphics: Vivante GC2000; Memory: 2GB DDR3; Ports: 3 USB 2.0, 1 HDMI, 1 S/PDIF out, 1 3.5mm analog audio out, 1 Gigabit Ethernet; Storage: 16GB eMMC, 1 3Gbps SATA port, 1 SD slot; Wireless: 802.11b/g/n; OS: MatrixTV

GIGABYTE BRIX Pro (GB-BXi7-4770R)

The BRIX Pro is an ultra-compact PC kit that's similar in size and design to Intel's NUC (Next Unit of Computing) barebones kit, which we reviewed in the March issue. The big difference between these small machines is the processing power of each. Intel's units feature CPUs that you'd typically find in Ultrabooks (the fastest NUC includes the Core i5-4250U, for example), while the BRIX Pro lineup comes with Intel's R-series BGA Haswell processors. We got a chance to check out the GB-BXi7-4770R that—surprise—is built with an Intel Core i7-4770R.

The Haswell chip at the heart of the BRIX PRO is a quad-core processor with Hyper-Threading that runs at a base clock of 3.2GHz and a max turbo of 3.9GHz. It's also got 6MB of Intel Smart Cache. That's some pretty impressive computing power, considering that the GB-BXi7-4770R, at 2.4 x 4.3 x 4.5 inches (HxWxD), can easily fit into a backpack with room to spare.

The BRIX Pro we reviewed (model GB-BXi7-4770R) is a mobile powerhouse. The unit's Iris Pro Graphics 5200 offers 40 GPU execution units and 128MB of embedded memory. The 40 execution units are double what you'll find in Intel's HD Graphics 4600/4400/4200 processor graphics—quite the performance boost. The on-package memory helps reduce memory bandwidth issues, and GIGABYTE indicates that the extra bandwidth will boost performance in 3D applications. The Iris Pro Graphics 5200 also features a maximum dynamic frequency of 1.3GHz. Support for Intel's Quick Sync Video, InTru 3D Technology, Clear Video HD Technology, and WiDi are all here, too.

The support for high-quality video makes the BRIX Pro a good option for people looking for a miniature HTPC. It could also be a nice fit in an office, as the ultra-compact PC can span video across two displays using both the HDMI and mini DisplayPort outputs. GIGABYTE includes a VESA mounting bracket to let you easily attach the computer to the back of an HDTV or monitor. This discrete mounting system also makes the BRIX GB-BXi7-4770R suitable for digital signage duties and any other environment where you want the PC hidden from view.

GIGABYTE calls the BRIX Pro an ultra-compact PC kit because it doesn't come with memory, storage, or an OS. Thankfully, these components are fairly easy to come by. The BRIX Pro's approach also gives you the chance to select storage and memory that best suit your needs. We'll note that the BRIX GB-BXi7-4770R requires DDR3L SO-DIMMS that are designed to operate at 1.35V. Our test unit wouldn't even boot with 1.5V SO-DIMMS. For storage, you'll be able to install a standard 2.5-inch drive and/or an mSATA SSD.

To access the SO-DIMM and mSATA slots, you'll need to unscrew the back panel. Together, the two SO-DIMM slots support up to 16GB of memory running at 1,333MHz or 1600MHz. Besides the mSATA slot, the BRIX GB-BXi7-4770R has a half-size mini PCI-E slot that GIGABYTE utilizes for an 802.11a/b/g/n/ac + Bluetooth 4.0 wireless module. We like that GIGABYTE has included wireless connectivity because it frees you from needing Ethernet access.

There's plenty of connectivity built into the BRIX Pro, too. On the front of the unit, there are two USB 3.0 ports and a headphone jack that doubles as a coaxial S/PDIF input. On the rear panel, you'll find the HDMI and mini DisplayPort outputs, as well as a Gigabit Ethernet port, two USB 3.0 ports, a Kensington lock slot, and the power input. We like the inclusion of the Gigabit Ethernet port, because it's always helpful to have a reliable, speedy connection, especially for media playback. The BRIX GB-BXi7-4770R supports HDMI version 1.4a and DisplayPort 1.2a standards.

Our benchmark numbers show that the GIGABYTE BRIX Pro is certainly capable of being a gaming box, provided the settings are right. At 1,920 x 1,200 and the highest settings, the BRIX Pro pumped out 21.4fps in Aliens vs. Predator; it produced 32fps when we tested at 1,280 x 800 (same settings). The system also did well in our processor-specific benchmarks. In Cinebench 11.5, it produced 7.07 points, which is around 1.5 points lower than what the stock-clocked Core i7-4770K typically delivers. The processor's Iris Pro Graphics 5200 also showed well in 3DMark Pro's Fire Strike test, with an overall score of 1398.

If physical size is the most important feature for your next system, the BRIX Pro is a great option. Its performance level is surprising, considering the size of the unit. Essentially, it's what you'd get with a high-end laptop, but for a fraction of the price. That alone makes it an appealing option for LAN party attendees. ■

BY NATHAN LAKE

GB-BXi7-4770R
$649
GIGABYTE
www.gigabyte.us

Test system specs: Processor: Intel Core i7-4770R (3.2GHz/3.9GHz); Motherboard: GIGABYTE M4HM87P; Graphics: Intel Iris Pro HD Graphics 5200; Memory: 4GB Kingston DDR3L-1600; Storage: 256GB OCZ Vertex 3, mSATA: 128GB ADATA SX300

Benchmark Results	GIGABYTE BRIX Pro
3DMark Professional	**1398**
Graphics Score	1501
Physics Score	8524
PCMark 8	
Creative Score	3292
SiSoftware Sandra 2014 Lite	
Dhrystone AVX2 (GIPS)	113.61
Whetstone iSSE3 (GFLOPS)	72.69
Multi-Media Integer AVX x32 (Mpixels/s)	320.64
Multi-Media Float FMA3 x16 (Mpixels/s)	254.38
Multi-Media Double FMA3 x8 (Mpixels/s)	148.76
Multi-Media Float/Double FMA3 x8 (Mpixels/s)	194.53
Integer B/F AVX/128 (GBps)	18
Floating B/F AVX/128 (GBps)	17.92
POV-Ray 3.7 Beta*	**1340.23**
Cinebench 11.5**	**7.07**
Games (1,920 x 1,200)	
Metro: Last Light (16XAF)	10.6
Aliens vs. Predator (4XAA, 16XAF)	21.4

* pixels per second

** points

ROG Poseidon GTX 780
$599.99
ASUS
www.asus.com/us

ASUS ROG Poseidon GTX 780

We've often lamented the fact that our GPUs, which tend to run extremely hot, get treated like second-class citizens when it comes to easy exotic cooling. Yes, you can install an aftermarket waterblock and add the graphics card to your custom loop. That's a pricey proposition, though, and you can kiss your warranty coverage goodbye. ASUS has taken a bold approach with its ROG Poseidon GTX 780 (model POSEIDON-GTX780-P-3GD5), installing an air cooler that doubles as a built-in waterblock.

This ROG (Republic of Gamers) graphics card consists of a custom cooler strapped to an overclocked GeForce GTX 780. The reference design GTX 780 has its stock clock set at 863MHz, with Boost 2.0 technology letting it climb to up to 900MHz when the card has some headroom to spare. ASUS was able to push those clocks to 954MHz (base) and 1,006MHz (boost), thanks in part to superior components and a very capable cooler.

Like many of the graphics cards from ASUS, this one's cooler is a DirectCU model, meaning the copper comes in direct contact with the GPU's heat spreader, instead of relying on the more traditional cooler design that slips a polished piece of nickel-plated aluminum between the two. The suffix of this DirectCU H2O cooler refers to a copper vapor chamber and a U-shaped liquid channel that does a three-fourths lap around the GPU. This channel opens on either end with a pair of G1/4 threaded fittings, into which you can install your choice of barbs with a variety of inner/outer diameters. ASUS finds that using the liquid-cooling function of the Poseidon GTX 780 can reduce GPU temperatures by an impressive 24 degrees Celsius, compared to the reference GTX 780's air cooler.

Not everyone is going to take advantage of the barb fittings, which is why ASUS also mounted an aluminum heatsink with a trio of heatpipes winding throughout, a pair of 90mm dust-proof fans, and a thin plastic heat shield designed to direct warm air out and away from the GPU. This cooler outperforms the reference design cooler by 7 C.

The hybrid liquid/air cooler isn't the only souped-up aspect of this graphics card. ASUS gave the GPU a 10-phase Super Alloy Power and DIGI+ VRM, which is designed to deliver 30% less power noise and dramatically better heat and stress resistance. Other features include "specially formulated concreted chokes," Japanese black metallic caps, and hardened MOSFETs that will deliver stable overclocking and a long life span.

The Poseidon GTX 780 is a dual-slot card and measures approximately 11.3 inches long (including the PCB). Power comes to it via 8-pin and 6-pin PCI-E power connectors. ASUS also warns that you'll need up to 300 watts of power just to run the Poseidon GTX 780; the PSU itself should push at least 600 watts of total power and have a 12V rail rated for at least 38 amps.

If you've been looking for a high-performance graphics card that has a solid air cooler and the guts to support liquid cooling out of the box, your options dwindle to just one. The ASUS ROG Poseidon GTX 780 is a very good option to have. ■

BY ANDREW LEIBMAN

Specs & Scores	ASUS ROG Poseidon GTX 780
Price	$599.99
Core clock	954MHz
Boost clock	1,006MHz
Memory clock	1,502MHz
Memory interface	384-bit
Memory	3GB GDDR5
3DMark Professional (Fire Strike Extreme)	**4694**
Graphics Score	4875
Physics Score	11105
Unigine Heaven 4.0	**(1,920 x 1,200)**
Score	1288
FPS	51.1
Games	**(1,920 x 1,200)**
Metro: Last Light (16XAF)	67fps
Aliens vs. Predator (4XAA, 16XAF)	80.2
	(2,560 x 1,600)
Metro: Last Light (16XAF)	46.33fps
Aliens vs. Predator (4XAA, 16XAF)	48.8fps

Test system specs: Processor: Intel Core i7-4770K; Motherboard: ASUS MAXIMUS VI FORMULA; RAM: 8GB ADATA XPG V2 DDR3-2400; Storage: 128GB Crucial RealSSD C300; OS: Windows 8 Enterprise (64-bit)

ASUS MAXIMUS VI FORMULA

When it comes to motherboards, ASUS seems to be of the opinion that more is better. (For the record, that's just fine with us.) The MAXIMUS VI FORMULA is a perfect example. This Z87-based motherboard is overflowing with features, including a set of threaded fittings to install liquid-cooling barbs on the VRM heatsink, digital power delivery, premium sound, speedy storage, enhanced durability, and loads of connectivity. To top it all off, the MAXIMUS VI FORMULA looks cool, thanks to the ROG Armor that covers much of the front and back of the PCB. Let's see how well this armored motherboard withstands our piercing scrutiny and punishing benchmarks.

Motherboard temperatures can impact a CPU's overclocking headroom, but because waterblocks for a motherboard's VRM and PCH aren't readily available, system builders usually have to rely on their boards' passive heatsinks to do the job. On the MAXIMUS VI FORMULA, ASUS adds its CrossChill VRM heatsink, which features two G1/4 threaded fittings. We like that ASUS opts to use standardized threaded fittings rather than building barbs into the waterblock, because you'll be able to use barbs and hoses that match your existing cooling loop.

Inside the CrossChill, there are water channel fins that increase the surface area for improved heat transfer. ASUS also installs a leak-proof rubber gasket to ensure a tight seal with the heatsink. According to ASUS, incorporating the CrossChill heatsink into your loop can reduce MOSFET temperatures by up to 23 degrees Celsius. Naturally, the heatsink over the VRM functions perfectly well as a passive cooler if you'd prefer to keep it dry, so to speak.

The MAXIMUS VI FORMULA's ROG Armor helps to lower system temperature, too. The ABS top cover thwarts any errant heat radiating from your graphics card(s). Thermal pads below the ROG Armor can move heat away from key components.

It only makes sense to surround such a high-end board with equally high-end components, and the MAXIMUS VI FORMULA is more than happy to oblige. ASUS provides support for memory speeds up to DDR3-3000, for example. You can use up to 80% of your system's memory (the motherboard supports a maximum of 32GB) to create a ROG RAMDisk that serves as a high-speed virtual storage drive. The RAM-based storage is 20 times faster than an SSD, according to ASUS, making it excellent for storing game images and any other important apps. Gamers will also like that the motherboard supports up to 2-way SLI or 3-way CrossFire.

ASUS has given this board's integrated audio an injection of awesome, using a host of high-quality components that fall under the banner "SupremeFX Formula." ELNA audio capacitors deliver outstanding fidelity and clarity, while WIMA film capacitors enhance high- and low-frequency sounds. Those with high-end headphones will like that the board sports a 600ohm headphone amplifier and a Cirrus Logic headphone digital/analog converter with a 120dB

MAXIMUS VI FORMULA
$299
ASUS
www.asus.com/us

signal-to-noise ratio. The whole audio path is physically shielded from electromagnetic interference using SupremeFX Shielding technology. Gamers can even take advantage of ASUS' Sonic Radar technology to show them where sounds and opponents are coming from via an in-game overlay. When you need to issue orders to your teammates, the board's built-in digital signal processing removes background noise, making your commands crystal clear.

The MAXIMUS VI FORMULA goes all out with connectivity. ASUS provides you with a ROG mini PCI-E combo module that supports 802.11a/b/g/n/ac and Bluetooth 4.0. The module also offers an M.2 socket where you can install a type 2242 SSD card. ASUS complements the built-in Intel Gigabit Ethernet controller with its ROG GameFirst II software that prioritizes network performance for games and critical applications. For internally connectivity, there are 10 6Gbps SATA ports, and headers are available to let you add more USB 3.0 and USB 2.0 ports, as well as an additional S/PDIF audio out. There are even eight controllable fan headers spread throughout board. It's a well-thought-out PCB design.

As is fitting with this motherboard, we tested it with the best components we could find, including a Core i7-4770K, an ASUS ROG POSEIDON-GTX780-P-3GD5, and 8GB of ADATA XPG V2 DDR3-2400. The motherboard performed superbly in all of our tests. In 3DMark Professional's Fire Strike Extreme test, we logged an overall score of 4694 and a graphics score of 4875. The motherboard scored high marks in the processor-intensive Cinebench 11.5 and POV-Ray 3.7 Beta—8.55 points and 1607.86 pixels per second, respectively. SiSoftware Sandra's Memory Bandwidth test showed that the MAXIMUS VI FORMULA took full advantage of the 2,400MHz ADATA memory, with speeds near 26GBps.

ASUS has done a great job of ensuring that every aspect of the motherboard enhances your overall PC experience. The overclocking capabilities and lightning-fast RAMDisk storage also mean that enthusiasts will be able to push the performance envelope with ease. There's really no doubt that the MAXIMUS VI FORMULA is a power user's motherboard. ■

Benchmark Results	ASUS MAXIMUS VI FORMULA
3DMark Professional (Fire Strike Extreme)	**4694**
Graphics Score	4875
Physics Score	11105
PCMark 8	
Creative Score	4746
SiSoftware Sandra 2014 Lite	
Dhrystone AVX2 (GIPS)	156
Whetstone iSSE3 (GFLOPS)	108.8
Multi-Media Integer AVX x32 (Mpixels/s)	446.21
Multi-Media Float FMA3 x16 (Mpixels/s)	409.83
Multi-Media Double FMA3 x8 (Mpixels/s)	239
Multi-Media Float/Double FMA3 x8 (Mpixels/s)	313
Integer B/F AVX/128 (GBps)	25.88
Floating B/F AVX/128 (GBps)	25.74
POV-Ray 3.7 Beta*	**1607.86**
Cinebench 11.5**	**8.55**
Games (2,560 x 1,600)	
Metro: Last Light (16XAF)	46.33
Aliens vs. Predator (4XAA, 16XAF)	48.8

* pixels per second

** points

BY NATHAN LAKE

Specs: Max memory: 32GB (DDR3-1600; Max OC: DDR-300); Slots: 3 PCI-E 3.0 x16; 3 PCI-E 2.0 x1; Storage: 10 6Gbps SATA ports; 1 M.2 port (supports type 2242 SSD card); Rear I/O: 1 DisplayPort, 1 HDMI, 6 USB 3.0, 4 USB 2.0, 1 optical S/PDIF out, audio I/O, clear CMOS button, ROG Connect On/Off; Form Factor: ATX; Warranty: 3 years
Test system specs: Processor: Intel Core i7-4770K; GPU: ASUS ROG POSEIDON-GTX780-P-3GD5; RAM: 8GB ADATA XPG V2 DDR3-2400; Storage: 128GB Crucial RealSSD C300; OS: Windows 8 Enterprise (64-bit)

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be quiet! Dark Power Pro 10 750W

We've always had a fondness for power supplies that offer variety when it comes to cabling, such as cables of different lengths and lots of options for SATA and Molex connectors. So when we saw the unprecedented assortment of cable options that be quiet! includes with the partially modular Dark Power Pro 10 750W, we geeked out a little.

For instance, this PSU comes with three cables for CPU power, each with a distinct connector(s)—a 4-pin, a 4+4-pin, and one with both an 8-pin and 4+4-pin. You'll only be able to connect one of the CPU power cables, but we appreciate that be quiet! gives you the flexibility to adapt the power supply to different builds. Similar mix-and-match options are available with the PCI-E, SATA, and Molex cables. For instance, there is a cable that offers a single SATA connector and one with a single Molex connector, as well as a cable that mixes SATA and Molex connectors. This way, you'll be able to select the modular cables that are ideal for your build.

be quiet! designs this 750W power supply with four 12V rails (two 25A, two 30A). You're not tied to the four-rail setup, though, because the Dark Power Pro 10 has a physical switch that mounts to your case's rear expansion slots and lets the PSU function as a 62A single-rail power supply. be quiet! indicates that the single-rail setup is ideal for overclockers. The multi-rail setup is safer, however, because each 12V rail is secured with its own overcurrent protection.

The Dark Power Pro 10 offers six 6+2-pin PCI-E connectors, which is enough to wire a triple SLI or CrossFire setup. Those with high-end GPUs will first need to consider their cards' power requirements, though. be quiet! tells us that the Dark Power Pro 10 750W can comfortably handle two top-of-the-line GPUs. A good number of SATA (nine) and Molex (nine) connectors are available, too.

The Dark Power Pro 10 750W offers a number of features aimed at reducing system noise. First, its 135mm SilentWings PWM fan uses an advanced fluid dynamic bearing that should lower operating noise. The SilentWings fan is also decoupled from the PSU body, resulting in less vibration. This PSU can also control the speed of four other system fans based on your case's internal temperature.

We benchmarked the Dark Power Pro 10 750W in its default four-rail configuration using a test system equipped with an Intel Core i7-4960X, a GIGABYTE GA-X79-UP4, and a GIGABYTE GeForce GTX 780 GHz Edition (GV-N780GHZ-3DG). We took our power measurements when the system was simultaneously running POV-Ray Beta 3.7 (stresses all CPU cores) and Aliens vs. Predator (stresses GPU). The Dark Power Pro 10 displayed a maximum wattage of 418W at a power factor of .992. The power factor is one of the higher we've seen in our testing, and the PSU was able to reproduce the impressive numbers each time we re-ran the stress tests.

The Dark Power Pro 10 750W delivered impressive results in our benchmark tests. Best of all, be quiet! provides you with a ton of cabling options. A smart fan control system tops it all off. This is a PSU that screams quality. ■

Specs	be quiet! Dark Power Pro 10 750W
Rated continuous (W)	750
12V rails	4
+12V rail configuration (A)	30/30/25/25
+5V max (A)	25
+3.3V max (A)	25
SLI/CrossFire-ready	Yes
Max wattage tested	418
Power factor tested	.992
Efficiency rating (as advertised)	Up to 93%
Fan	135mm
PCI-E	6 (6+2-pin), 1 (6-pin)
Main 12V	20+4-pin
CPU 12V	2 4+4-pin, 1 8-pin, 1 4-pin
SATA	9
4-pin Molex	9
Floppy	2
Length (including cable bend)	8 inches
Warranty	5 years

BY NATHAN LAKE

Dark Power Pro 10 750W
$199.99
be quiet! | www.bequiet.com

Test system specs: Processor: Intel Core i7-4960X; Motherboard: GIGABYTE GA-X79-UP4, GPU: GIGABYTE GV-N780GHZ-3GD; Memory: 16GB Patriot Viper Xtreme DDR3-1866; Storage: 240GB OCZ Vertex 3; OS: Windows 8 Enterprise (64-bit)

Dead Silence 140mm
$21.99
Aerocool
www.aerocool.us

Dead Silence 120mm
$19.99
Aerocool
www.aerocool.us

Aerocool Dead Silence 120mm/140mm Fans

Best-case scenario, most enclosures you buy today will include one intake fan installed in the front panel and an exhaust fan in the rear panel, with some foregoing the intake fan entirely to reduce the price tag as much as possible. But if you're building a powerful PC, you're going to need a lot more airflow than one or two fans can deliver. When it comes to air cooling, normally we'd caution that your ambient temps will fall as your system noise increases, but Aerocool's new Dead Silence family of case fans take ultra-quiet to the next level.

Aerocool recently sent us a blue 140mm and a red 120mm model. Dead Silence fans also come in black and white, and all models are available in either 120mm or 140mm. Each color fan comes with a quartet of matching LEDs, except the black fan, which is unlit.

One of the first things we noticed when we unpackaged the Dead Silence fans was the profusion of molded rubber on the fan blades. The black portions are constructed of the same hard plastic as the fan frame, while the colored portions are made of a soft rubber, which Aerocool designed to absorb noise as air passes over the blades. There are rubber inserts at each of the fan's four corners that act as vibration-quelling mounts; Aerocool calls them Silencer Blocks. The Silencer Blocks also feature a unique pattern that first channels sound away from the frame and then dampens it as the sound reaches the edge of the inner wall. The underside of the blades features a polka dot pattern that Aerocool claims effectively minimizes air turbulence that occurs under the blades. The blade angle has also been tuned to maximize airflow while minimizing sound output.

The Dead Silence fan motor utilizes a fluid dynamic bearing design, which delivers the same precision rotation as ball bearing-based fans and better shock protection than sleeve-bearing type fans. FDB fans also have a fully lubricated shaft for less friction, lower temperatures, quieter operation, and a longer life span than any of the aforementioned fan types (greater than 100,000 hours). The Dead Silence fans have a low starting voltage of 3V before gradually ramping up to the fan's standard 12V, but you can force them to operate in a low-voltage mode using the bundled 7V voltage reduction cable. Other items Aerocool bundles in include four anti-vibration screws, fully sleeved cables, and a 3-pin fan to 4-pin Molex adapter.

In our tests, the fans (both 120mm and 140mm fans running at 1,500rpm) emitted barely a mumble, just inches away from our ears. Using the 7V cable reduced the mumble to a practically inaudible whisper. For those who think improving a case's airflow means sacrificing silence, Aerocool's Dead Silence fans are here to set the record straight. ■

BY ANDREW LEIBMAN

Specs (Dead Silence 120mm): Dimensions: 120 x 120 x 25mm; Speed: 1,500/1,100rpm (12V/7V); Airflow: 81.5/62.5cfm (12V/7V); Noise: 23.1/14.8dBA (12V/7V); Available colors: Black, red, blue, white

Specs (Dead Silence 140mm): Dimensions: 140 x 140 x 25mm; Speed: 1,500/1,100rpm (12V/7V); Airflow: 93.4/71.2 (12V/7V); Noise: 23.4/15.5dBA (12V/7V); Available colors: Black, red, blue, white

Cooler Master HAF Stacker 935

HAF Stacker 935
$169.99
Cooler Master
www.coolermaster-usa.com

As its name suggests, Cooler Master's HAF Stacker PC case system is a fusion of design elements from the HAF (High Air Flow) and Stacker case families. It's also a set of modular case units that you can combine in a variety of combinations and configurations to build just about any kind of PC you can dream up.

Want a gaming PC with its own attached Mini-ITX game server? Can do. Looking to build an ATX rig but need more space for watercooling gear than most standard towers will support? Not a problem. Trying to build a single massive case that encompasses the PCs of your entire DOTA team? (There are people doing this for LAN parties, you know.) The HAF Stacker system can handle such a build, and much, much more.

The base of the HAF Stacker system is the HAF Stacker 935, a PC tower case with distinctive HAF design notes on the outside and traditional Stacker roominess inside. Cooler Master refers to the 935 as a "mod tower," because it's the cornerstone of a unique, modular set of enclosures: the 935, the 915R, and the 915F. The 935 comes with a 915R, which is a great addition to the 935 but also makes for a pretty nice Mini-ITX enclosure all on its own.

For its part, the 935 has three tool-less external 5.25-inch bays and six 2.5-/3.5-inch internal bays, the latter of which are split up into two three-bay cages. You can remove one or both of them if you like (there's an SSD mount on the backside of the motherboard tray for a stealth boot drive), but you won't have to remove anything to accommodate high-end graphics cards. Even with its drive cages in place, the 935 will support cards 13.9 inches long, and the 915R up top (which has a three-bay drive cage of its own for 3.5- and 2.5-inch drives, for a total of nine) will take cards up to 14.17 inches in length.

The 2.5-/3.5-inch bays incorporate Cooler Master's excellent slide-in drive trays, and although you'll find similar devices in use in other brands, we really like the way Cooler Master trays (and everything else in the case, for that matter) fit perfectly and work just the way they should. Cable management is a snap with the HAF Stacker, as there is an abundance of cable management holes (including roomy pass-through spaces at the top and bottom of all Stacker units) and plenty of room between the 935's motherboard tray and its right side panel.

Together, the 935 and its included 915R represent a wealth of component and cooling real estate. There's very little you can't build with these units working together, but in the event that you'd like to add more room, you can easily add another 915R or 915F, and you can add them above or below the 935 and above or below the 915R, depending on your needs. With the removal of a few screws, the 935's feet come off to reveal the same sliding rail mechanism that connects the 915 up top, and both the 915R and 915F units have feet and top panels that are optional, as well. One other item of interest: Although the HAF Stacker's USB ports, audio I/O jacks, and power button come installed at the top of the 935 by default, they are also modular and can easily be relocated to the top of the 915R.

In terms of their functional designs, the 915R has the aforementioned triple-bay drive cage up front beneath a 5.25-inch external bay, with a Mini-ITX motherboard mount at the rear beneath a power supply mount. The 915F moves the drive bay back to its middle, with the 5.25-inch bay and a PSU mount up front, while the Mini-ITX board mount is located beneath an included 120mm exhaust fan.

Speaking of fans, the 935 comes with one 140mm exhaust fan installed in the rear and one 92mm intake fan installed behind the front panel of the 915R. You can install two 120mm fans at the front of the 935, and its rear fan mount also accommodates 120mm units. The side panels of the 915R will also accept either two 140mm fans each (for a total of four) or three 120mm units each (a total of six). As you would guess, the side panels of the 915R are also good places to mount dual rads.

With Cooler Master's Stacker 935 and its included 915R, if you can dream it you can build it. The ability to add further 915R and/or 915F units with ease makes the HAF Stacker system very easily the most flexible case system that we've ever seen, and as you will see in this month's "Mad Reader Mod" feature, it's also a great canvas for imaginative modders. ■

BY CHRIS TRUMBLE

Specs: Dimensions: 28.8 x 9.25 x 22.75 inches (combined HxWxD); Materials: Steel, polymer; Motherboard support: Mini-ITX, mATX, ATX, E-ATX; Drive bays: 3 5.25 external (+1 915R), 6 2.5-/3.5-inch internal (+3 915R), 1 2.5-inch SSD mount (motherboard tray); Fans (included): 1 92mm front (915R), 1 140mm rear; Fans (optional): 2 120mm top (915R), 2 120mm front, 1 120mm rear, 6 120mm/4 140mm side (915R); Ports: 2 USB 3.0, 2 USB 2.0, audio I/O

Premier Pro SP920 256GB
$159.99
ADATA
www.adata-group.com

Benchmark Results	ADATA Premier Pro SP920 256GB
CrystalDiskMark 3.0.3 (64-bit, default)*	
Sequential read	498
Sequential write	361
512K read	462
512K write	360.3
4K read	29.6
4K write	130
4K QD32 read	394.6
4K QD32 write	333.5
CrystalDiskMark 3.0.3 (64-bit, all 0x00, 0 fill)*	
Sequential read	502.3
Sequential write	361.5
512K read	460.8
512K write	360.1
4K read	29.97
4K write	130.1
4K QD32 read	396.1
4K QD32 write	333.3
AS-SSD*	
Seq read	504.82
Seq write	342.67
4K read	25.15
4K write	112.61
4K-64Thrd read	371.29
4K-64Thrd write	266.42
*MBps	

ADATA Premier Pro SP920 256GB

Continuing its assault on the SSD market, ADATA has come out guns blazing with a brand-new lineup of drives. The Premier Pro SP920 family of 6Gbps SATA SSDs has a little something for everyone, in terms of capacity. Maybe you want a fleet-footed boot drive and nothing more. Perhaps the kinds of files you want to store on your new SSD is "all of them." With capacities of 128GB, 256GB, 512GB, and big ol' 1TB, the Premier Pro SP920 family has you covered. We split the difference and called the 256GB model into the station for questioning.

The 256GB SP920 certainly has an impressive rap sheet. Previous ADATA SSDs relied on SandForce silicon for their storage controllers, but the controller under the hood of the SP920 is Marvell's 88SS9189. Like the SSD itself, this controller is new, shiny, and laden with tasty treats. We know you care deeply about performance, and the Marvell 88SS9189 has plenty. Sequential reads and writes peak at 560MBps and 360MBps, respectively, while random 4K reads and writes can top out at an obscene 96,000 IOPS/80,000 IOPS. Better still, our test results showed that it makes no difference to this controller whether a particular workload is compressible or not.

Marvell's controller also gives you NCQ, TRIM, and S.M.A.R.T. support, as it should, and it also has a hardware-based AES-256 encryption engine. ADATA fills this drive with synchronous MLC NAND, set up in eight channels. Although the SP920 is a slender 7mm thick, ADATA includes a spacer to fatten it up for 9.5mm bays. And because we're all special little snowflakes, ADATA gifts every SP920 with a product key for Acronis True Image HD. (We found ours under the drive itself.)

As our benchmark results show, the SP920 is a burner. What it won't do, though, is burn up your budget; you can have the 256GB drive for about 62 cents a gig. That's hot. ■

BY VINCE COGLEY

Specs: Sequential read/write (advertised): 560MBps/360MBps; Max 4K random read/write (advertised, Iometer): 96,000 IOPS/80,000 IOPS; Interface: 6Gbps SATA; Warranty: 3 years

Test system specs: Intel Core i7-4770K; Motherboard: ASUS MAXIMUS VI FORMULA; GPU: ASUS ROG POSEIDON-GTX780-P-3GD5; RAM: 8GB ADATA XPG V2 DDR3-2400; Storage: 128GB Crucial RealSSD C300; OS: Windows 8 Enterprise (64-bit)

GeForce GTX 750 Ti
$169.99
GIGABYTE
www.gigabyte.us

GIGABYTE GeForce GTX 750 Ti

It's true, we spill more ink writing about flagship GPUs, architectures, and the high-priced graphics cards that house them than we do about entry-level and mainstream cards. But for a vast majority of the general PC gaming populace, the mainstream graphics card is what will ultimately end up in their systems. GIGABYTE just sent us an intriguing option for those gamers who were entertaining questionable means of making money just to play the games they love: the GeForce GTX 750 Ti (model GV-N75TOC-2GI).

This card features NVIDIA's newest GPU architecture, codenamed Maxwell. The GM107 GPU that serves as the brains behind this graphics card consists of 1.87 billion transistors. Architecturally speaking, the GTX 750 Ti features five streaming multiprocessors (SMMs, formerly SMX), each of which has four groups of 32 CUDA cores. That's a total of 128 CUDA cores per SMM, versus 192 homogenized CUDA cores per each of Kepler's SMX units. The four groups of CUDA cores in each of Maxwell's SMMs has access to dedicated warp schedulers and registers, as well as their own texture cache. Although it's not as fast as the GTX 660, the GTX 750 Ti has a 75W TDP, compared to the GTX 660's 140W TDP.

Like the reference design from NVIDIA, GIGABYTE's card has a 128-bit memory bus and 2GB GDDR5, clocked at the stock 1,350MHz. The stock core and boost clocks are 1,020MHz and 1,085MHz, respectively, but GIGABYTE wasn't about to pass up the opportunity to milk a little extra performance from this card's more energy-efficient GPU. This card boasts core and boost clocks of 1,033MHz and 1,111MHz, respectively.

As you'd expect, the cooler on this card also gets some special treatment. It features a WINDFORCE 2X cooler, which consists of a pair of ultra-quiet 75mm PWM fans and a large, 8mm S-shaped copper heatpipe surrounded by a multitude of aluminum fins. An angular black plastic heat shroud features the WINDFORCE logo and matches the style we've seen on most of the recent GIGABYTE cards we've tested. For power, this card relies on a single 6-pin PCI-E power connector. Overall, GIGABYTE's GTX 750 Ti measures 7.5 inches long. On the backplane, you'll find a dual-link DVI-I, DVI-D, and two HDMI ports.

Like many of the GIGABYTE cards we see, this GTX 750 Ti features Ultra Durable 2 VGA technology, which consists of Japanese solid state caps, a lower RDS(on) MOSFET design, and ferrite core chokes. All this helps the card perform better, run cooler, and overclock more reliably.

This card couldn't quite handle the game benchmarks we ran at a stratospheric 2,560 x 1,600, but its performance improved dramatically at 1,920 x 1,200, which means 1080p is probably this card's sweet spot when it comes to modern games. With GIGABYTE's new GeForce GTX 750 Ti, gamers on a budget can get a very compelling experience. ■

By Andrew Leibman

Specs & Scores	**GIGABYTE GeForce GTX 750 Ti**
Price	$169.99
Core clock	1,033MHz
Boost clock	1,111MHz
Memory clock	1,350MHz
Memory interface	128-bit
Memory	2GB GDDR5
3DMark Professional (Fire Strike Extreme)	**1970**
Graphics Score	1958
Physics Score	13653
Unigine Heaven 4.0	**(1,920 x 1,200)**
Score	461
FPS	18.3
Games	**(1,920 x 1,200)**
Metro: Last Light (16XAF)	28fps
Aliens vs. Predator (4XAA, 16XAF)	33.6fps
	(2,560 x 1,600)
Metro: Last Light (16XAF)	17.67fps
Aliens vs. Predator (4XAA, 16XAF)	20.2fps

Test system specs: Processor: Intel Core i7-4960X; Motherboard: GIGABYTE GA-X79-UP4; RAM: 16GB Patriot Viper Xtreme DDR3-1866; Storage: 1TB Western Digital Black HDD; OS: Windows 8 Enterprise (64-bit)

SSD 730 480GB
$480
Intel
www.intel.com

Intel SSD 730 480GB

The champ is back.

In the beginning, the landscape of consumer SSDs was wild, weird, and wondrous. The first solid-state drives used SLC NAND and made a mockery of hard drives' performance. They also cost a mortgage payment or two. Even for power users, these early SSDs were the definition of a vanity buy, the teacup giraffe of PC components.

Intel was one of the first manufacturers to bring balance to the Force, as it were. The X18-M and X25-M featured vastly more affordable MLC NAND and Intel's homebrewed storage controller; these SSDs still outmatched hard drives in terms of performance, but it didn't take a king's ransom to retain their services.

Enthusiasts came out in droves to buy these SSDs. Intel used its own storage controllers for a few years before switching to third-party silicon. Well, now a few more years have passed, and if you're still carrying a torch for an SSD controller that's Intel born and bred, you're in luck: The new SSD 730 drives are all Intel, through and through.

The SSD 730 series, formerly code-named "Jackson Ridge," relies on Intel's third-generation controller and 20nm NAND flash, but with a clever little twist. The SSD 730's controller and NAND are both overclocked—from 400MHz to 600MHz in the case of the controller and from 83MHz to 100MHz for the NAND. Despite tinkering with the SSD's clocks, Intel throws an impressive five-year warranty behind the SSD 730 Series. The drives' write endurance, to 70GB of writes per day, jumps out as a spec for a drive that belongs in a server rack, not a power user's gaming rig.

The 480GB SSD 730 that Intel sent us promises sequential reads and writes of 550MBps and 470MBps, respectively. Random reads and writes are mighty fine, too, pushing the needle up to 89,000 IOPS (read) and 74,000 IOPS (write). Better still, performance scales incredibly well when you stripe a pair of SSD 730s together, according to Intel.

These claims, as it turned out, ain't too far from the truth. Our benchmark results loudly declared what we suspected all along: Intel still knows how to make a damn good SSD. Welcome back, guys. We've missed you. ■

BY VINCE COGLEY

Benchmark Results	Intel SSD 730 480GB (single drive)	Intel SSD 730 480GB (x2; RAID 0)
CrystalDiskMark 3.0.3 (64-bit, default)*		
Sequential read	446.2	940.3
Sequential write	486.1	973.2
512K read	404.7	754.2
512K write	471.2	883.9
4K read	34.65	27.61
4K write	114.7	119.1
4K QD32 read	366.7	612.1
4K QD32 write	323	634.4
CrystalDiskMark 3.0.3 (64-bit, all 0x00, 0 fill)*		
Sequential read	462.8	936.2
Sequential write	474.8	927.3
512K read	402.2	727.7
512K write	468.2	830
4K read	29.25	31.68
4K write	114.7	119.3
4K QD32 read	366.4	612.6
4K QD32 write	322.9	636
AS-SSD*		
Seq read	496.16	1013.06
Seq write	466.8	903.61
4K read	28.45	30.01
4K write	100.2	103.2
4K-64Thrd read	346.27	603.97
4K-64Thrd write	257.41	493.23
*MBps		

Specs: Sequential read/write (advertised): 550MBps/470MBps; Max 4K random read/write (advertised): 89,000 IOPS/74,000 IOPS; Interface: 6Gbps SATA; Warranty: 5 years
Test system specs: Intel Core i7-4770K; Motherboard: GIGABYTE GA-Z87X-UD7 TH; GPU: ASUS ROG POSEIDON-GTX780-P-3GD5; RAM: 8GB ADATA XPG V2 DDR3-2400; OS: Windows 8 Enterprise (64-bit)

State-Of-The-Art Standards

SATA Express

Whenever components available at retail begin to approach the theoretical bandwidth limits defined by the protocols they use, you can bet a new standard or a faster revision of the current one is on the verge of ratification by the appropriate industry associations. That's exactly the case with SATA.

Today's protocol revision, SATA III (or SATA 3.x or SATA 6Gbps), has a real-world maximum data rate of around 600MBps. As our longtime readers have surely noticed, we've tested numerous SSDs that achieve nearly those speeds in reads, with write speeds not too far behind.

Even though SATA's pipeline for SSDs is just a few dozen megabytes per second away from becoming a bottleneck, the industry organization behind the standard has already said that it doesn't plan to aggressively push for a 12Gbps SATA 4.0 revision (based on the existing enterprise-grade Serial Attached SCSI interface) anytime in the foreseeable future. According to the SATA-IO (Serial ATA International Organization), a 12Gbps SATA standard would require controllers that are an order of magnitude more complex with significantly larger ICs, which would gobble up valuable motherboard real estate and cost more to develop and manufacturer. Existing cables wouldn't be sufficient to handle the higher bandwidth, either, adding another cost premium to SATA 4.0's bottom line. All of the above would also preclude it from quick adoption by AMD and Intel, the twin gatekeepers of PC chipsets, deeming technologies worthy of inclusion or dooming them to perpetual exclusion.

SATA is set for its next technological leap forward.

Although the next stage in SATA's evolution is decidedly more incremental, SATA Express is almost here. Read on to learn what makes the next SATA revision worth getting excited about.

SATA's Transition

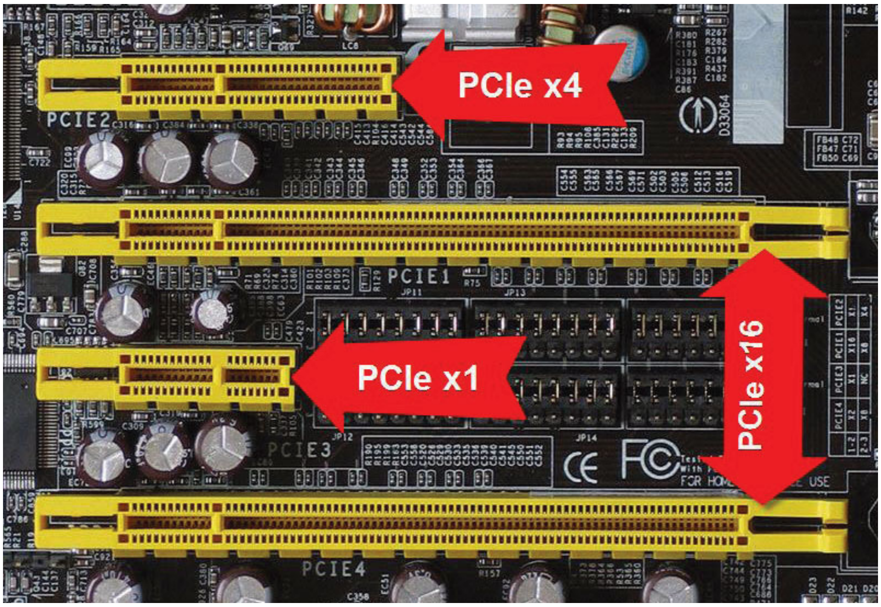
In 2003, the Serial ATA Workgroup (which would later become SATA-IO) initially proposed the Parallel ATA replacement, discarding the 80-pin interface plagued by crosstalk (remember those ribbon cables?) in favor of a serial interface that consisted of two pairs of conductors capable of passing data between two nodes, one bit at a time. The SATA interface was able to blow past the PATA interface largely thanks to its ability to run with a significantly faster clock. Narrower cables, smaller connectors, and a dramatic increase in the number of devices you could connect to the chipset were other factors that helped endear SATA to computing enthusiasts.

Jumping ahead to 2009, SATA 3.0 is finalized, and SSDs are still a fairly new innovation in personal computers. A mere two years later, SandForce releases its

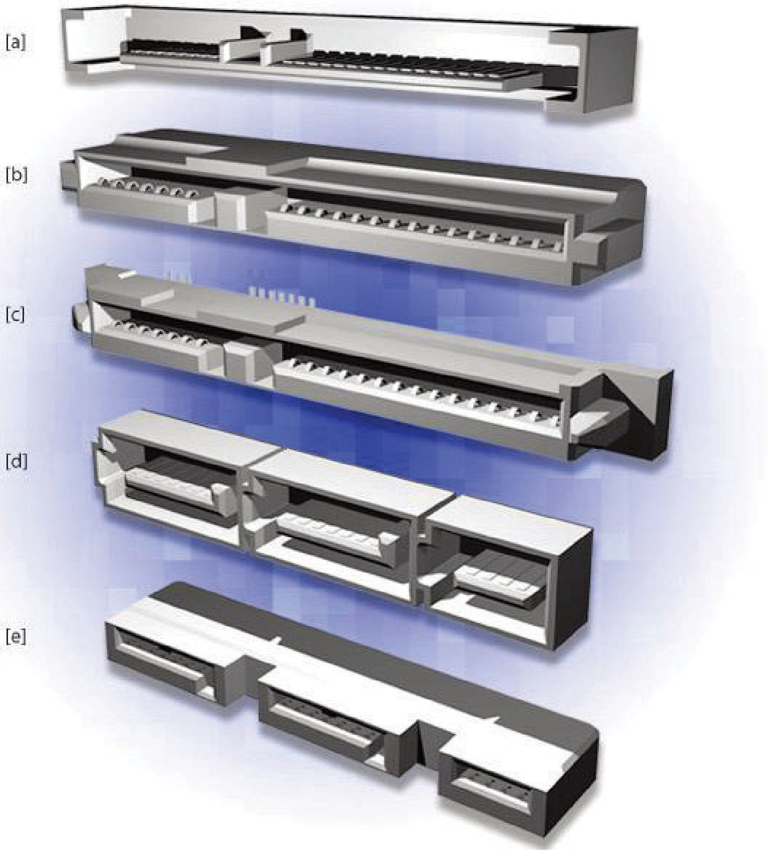
SF-2200 family of controllers for consumer SSDs. The SF-2200 controllers pushed flash-based storage performance to up to around 80% of the standard's maximum data rate.

Once hardware outpaces a standard, even if that hardware is limited to the cutting edge of the market, it's already too late. Innovation halts, sales slump, and consumers and manufacturers begin searching for something else; the standard is dead in the water. Although SSDs still make up a small portion of the overall storage market, according to IHS iSuppli, there were 57 million SSD shipments in 2013, and by 2017, that number is expected to balloon to 190 million units. With SATA 4.0 clearly off the table, there needs to be a performance incentive to help move that number of units, and you might be surprised to learn that another standard, PCI Express, is very likely to be behind the wheel for this next phase of SATA's evolution.

Formerly called HSI (High Speed Interconnect) and later 3GIO (3rd Generation I/O), PCI Express came into existence in 2003, the same year as the SATA interface, coincidentally. The protocol it replaced, PCI, used a parallel bus interface in which every device (up to a maximum of five devices) connected to the PCI host shared the same address, data, and control lines, which restricted communications to a single master at a time and in just one direction. Clock rates on PCI were also reduced to the speed of the slowest component connected, and electromagnetic interference between the wires had become increasingly cost-prohibitive to prevent. PCI Express dumped the parallel bus and relied on an interface that essentially serialized the serial interface. PCI-E is a point-to-point serial interface that supports dedicated links between each component and the PCI-E hub; it lets full-duplex communication take place between the hub and component. As such, multiple PCI-E devices can communicate with the hub simultaneously without suffering a delay or taking a bandwidth hit from a slower-performing component.



You probably have more PCI Express lanes than you know what to do with. SATA Express knows just what to do with them.



There are a variety of connectors currently on the table for use with SATA Express devices and motherboards.

Traditionally, each link extending from the PCI-E hub corresponds to a physical slot, but the slots come in different form factors that support different numbers of lanes (each of which consists of two differential signaling pairs, one for sending data and the other for receiving). The slot attached to a single-lane PCI-E interface is called a PCI-E x1 (by one) slot, and it sends one bit per clock cycle. The x4, x8, and x16 slots each transmit four, eight, and 16 bits per clock cycle, respectively.

Each PCI-E lane has the bandwidth to handle bidirectional 250MBps transfer rates. Four years after PCI-E's debut, the 2.0 revision effectively doubled the data rate for each PCI-E lane—500MBps in each direction. The latest version, PCI-E 3.0, alters the encoding scheme to dramatically reduce the overhead required to shift packets between the PCI-E hub and the individual devices. Where PCI-E 2.0 transmissions could have up to 20% of their total throughput set aside for overhead, PCI-E 3.0's overhead costs are closer to 1.5% of the total available throughput. The more efficient encoding scheme translates to a real-world performance boost, delivering a per-lane 985MBps data rate. Based on these numbers, you can see how the SATA protocol could realize significant performance improvements by tapping into the latest PCI-E revisions.

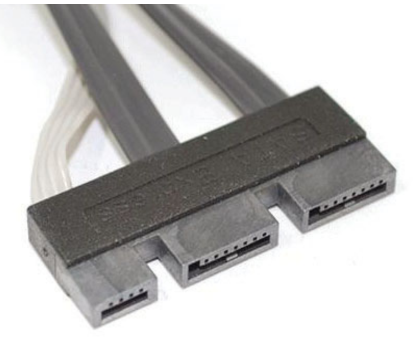
Big B Or Little B?

Before we delve into SATA's transformation, you may have noticed that we aren't using bits per second to express speeds. Although they both utilize serial data links, SATA and PCI-E encode data differently, making it difficult to compare data rates using Mbps/Gbps. This is because SATA's 8b/10b (10-bit symbols used to encode 8-bit words) encoding scheme lets the 6Gbps data rate translate to a 0.6GBps data rate. PCI-E 3.0, on the other hand, uses a 128b/130b (130-bit symbols used to encode 128-bit words) encoding scheme, which lets the protocol achieve a far more efficient 8Gbps per lane to nearly 1GBps per lane data rate translation. Both PCI-E 2.0 and 1.0 rely on the same 8b/10b encoding scheme as SATA, and as a result the peak 2.5Gbps and 5Gbps per lane data rates for those protocols translates to 0.25GBps and 0.5GBps per lane, respectively. In this way, a single lane of PCI-E 3.0 has an approximate 67% advantage in GBps over SATA III. And the new SATA 3.2 revision supports even more than that.

All Aboard The SATA Express

On August 8 2013, the SATA-IO announced that the SATA Express (or SATA 3.2) revision, which is a new revision that lets the PCI-E bus double as a SATA interface, had been finalized. The SATA Express connector will let users connect new SATA Express devices (most likely in the form of SSDs), traditional SATA devices, and traditional PCI-E devices to a supporting motherboard. In certain cases, adapters may be necessary.

This PCI-E storage device features a SATA Express interface.



This SATA Express connector is essentially two standard SATA III connectors with a supplementary third block of contacts.

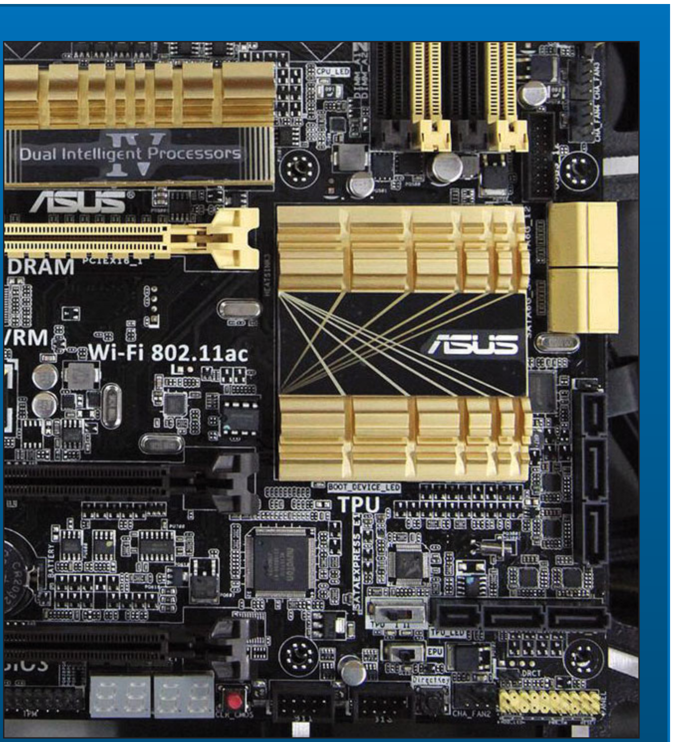
As we mentioned above, a single PCI-E 3.0 lane has more than a leg up on SATA III, but SATA Express can utilize up to two PCI-E lanes, which gives it peak data rates of up to approximately 2GBps.

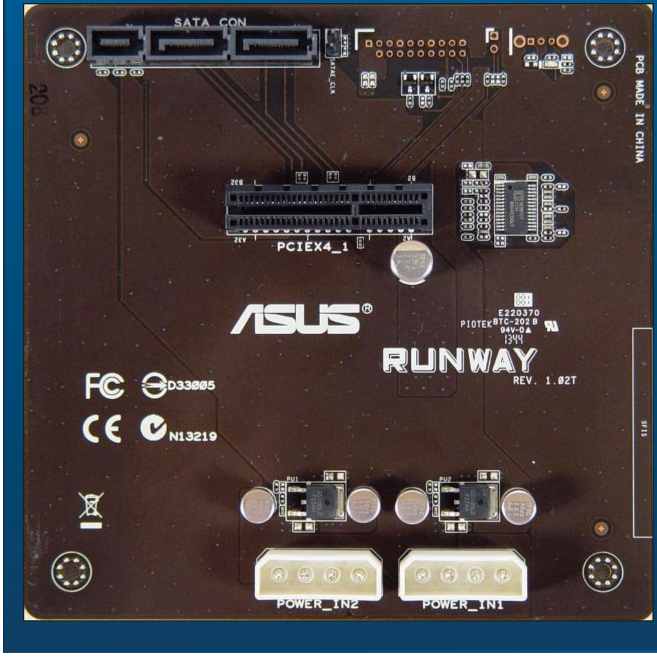
Because there are two protocols involved, the terminology used to refer to the new SATA Express devices and components can get tricky. According to the SATA-IO, the SATA Express specification refers to the host (currently a discrete IC separate from the chipset) and device connectors that are capable of supporting SATA or PCI-E devices. SATA Express connectors refer to the physical interface on the motherboard and on the device itself. The SATA Express host refers to a system that has both the SATA Express host connector and the logic to switch between PCI-E and SATA depending on the device connected. The term "SATA Express PCI-E device" refers to a storage device that features a SATA Express connector.

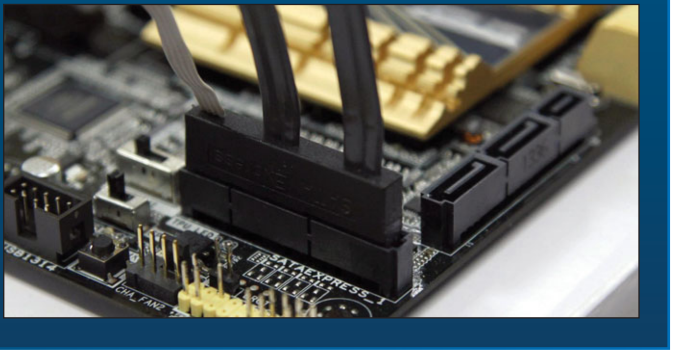
What will the SATA Express connector look like? Depending on the type of hardware it will support, the SATA-IO proposes a few different options. One of the proposed plugs features a uniform row of contacts with notches to support PCI-E devices made for SATA Express. Another supports a pair of standard SATA III cables, doubling as two discrete SATA III ports. This latter design is the one ASUS opted to use on its SATA Express prototype. (See the "SATA Express First Look" sidebar for more information.)

SATA Express First Look

Enthusiasts' best chance to get their hands on SATA Express will come from a motherboard manufacturer that opts to include it in one of its higher-end boards. ASUS has already developed a prototype Z87 motherboard that sports a pair of SATA Express connectors. Although no SATA Express PCI-E devices exist, ASUS has been shipping its Runway module out with the prototype motherboard, which converts the SATA Express signal to a PCI-E x4 signal. Using this setup, testers have been able to run PCI-E-based SSDs and realize performance well beyond that of SATA III.







AHCI vs. NVMe

SATA Express PCI-E devices need a software foundation that facilitates the exchange of data between them and the attached host system memory. Traditional SATA-based storage devices use AHCI (Advanced Host Controller Interface), which was supported in Microsoft's operating systems starting with Windows Vista. This technology enables device-level support for hot plugging (lets the user plug and unplug a given component without first shutting the system down) and Native Command Queuing, which means different things for HDDs and SSDs. In mechanical hard drives, NCQ refers to the scheme whereby the drive can reorder the pending read/write commands to better suite where the requested data is located on the platters. It takes longer for the platter to make a single revolution than it does for the actuator arm to skip across the surface of the platter, so NCQ lets the hard drive queue up read and write commands based on a more latency-aware sequence. This effectively decreases the number of revolutions necessary to perform the commands. In SSDs, NCQ offsets host latency by queuing commands and using pipelines to process commands concurrently. The benefit of a SATA Express PCI-E device that relies on AHCI is that it retains compatibility with SATA software environments and most major operating systems currently in use. The drawback, however, is that AHCI was built with mechanical hard drives in mind, not SSDs. As a result, AHCI can only handle 32 simultaneous commands.

The alternative software foundation that SATA Express PCI-E devices will support is NVMe (Non-Volatile Memory Express), which was built from the ground up to support SSDs. NVMe can handle up to 64,000 queues with 64,000 simultaneous commands each. NVMe was first proposed in 2011, but SATA Express is the first time the technology has been implemented and available (at least as engineering samples). As such, support for it is significantly more limited than with AHCI.

NVMe isn't compatible with SATA software, but you can visit www.nvmexpress.org to access drivers for Windows, Linux, and other operating systems. The LSI SandForce SF3700 controller family, which came out late last year, supports NVMe-based devices, but none were available to consumers for purchase at press time. At CES 2014, a Kingston HyperX prototype with this controller (expected to support NVMe via post-launch firmware update) can use four PCI-E 2.0 lanes to achieve up to 1,800MBps sequential read/write speeds and 150K/81K random IOPS. NVMe-based components are slated to appear in the second half of 2014.

Controllers from LSI Sandforce are likely to be behind the SATA Express devices you see in the very near future.

SATA 3.2 Miscellanea

Typically, protocol revisions include a number of improvements and changes, and SATA 3.2 is no exception. In addition to SATA Express, the updated protocol also brings with it support for microSSDs, or single-chip SATA SSDs that are ideally suited to embedded storage applications. The Universal Storage Module, which was a part of the SATA 3.1 revision, gets a form factor revision, which shrinks the module's thickness from 14.5mm to 9mm, called USM Slim. This update is targeted at improving the removable and expandable storage options for gadgets.

To bolster the protocol's power efficiency, SATA 3.2 includes the new DevSleep specification, which lets the storage device conserve energy by entering a very low power state. This feature is designed to improve battery life in Ultrabooks, as the new protocol's Transitional Energy Reporting feature, which provides the SATA host with granular data about the storage device and its energy consumption to improve the efficiency of switching between power management modes.

With SSHDs (that is, hard drives with integrated flash storage designed for caching) growing in popularity, SATA 3.2 contains a tweak that lets the host queue commands for the reading and writing of log data, which improves performance of these types of storage devices.

Finally, those with a RAID array will appreciate the new Rebuild Assist feature, which lets the SATA host identify the corrupted data on a failed drive in the RAID array so that it can more quickly rebuild that data on a replacement device.

When Can I Get SATA Express?

As we went to press, SATA Express was nowhere to be found on Intel's or AMD's chipset roadmaps. That doesn't mean that the protocol won't make the chipset varsity team eventually; it just won't be happening in the immediate future, namely in Intel's Haswell-E revamp scheduled to land later this year.

We don't have a specific time frame for SATA Express, but there are a lot of stars that have to align first. Motherboard makers like ASUS and GIGABYTE have to begin selling retail boards that support the standard; SATA Express controllers have to become available, likely starting with LSI Sandforce, which may be holding out until NVMe read/write performance (and, likely, OS-level driver support for NVMe) is good enough to be a compelling alternative to AHCI-based devices; and finally, major SSD manufacturers need to put those controllers to use by making SATA Express PCI-E SSDs available for purchase. Arguably, all of these could happen in a relatively short amount of time, or it could take significantly longer than anyone expects. Our money's on sooner rather than later. ■

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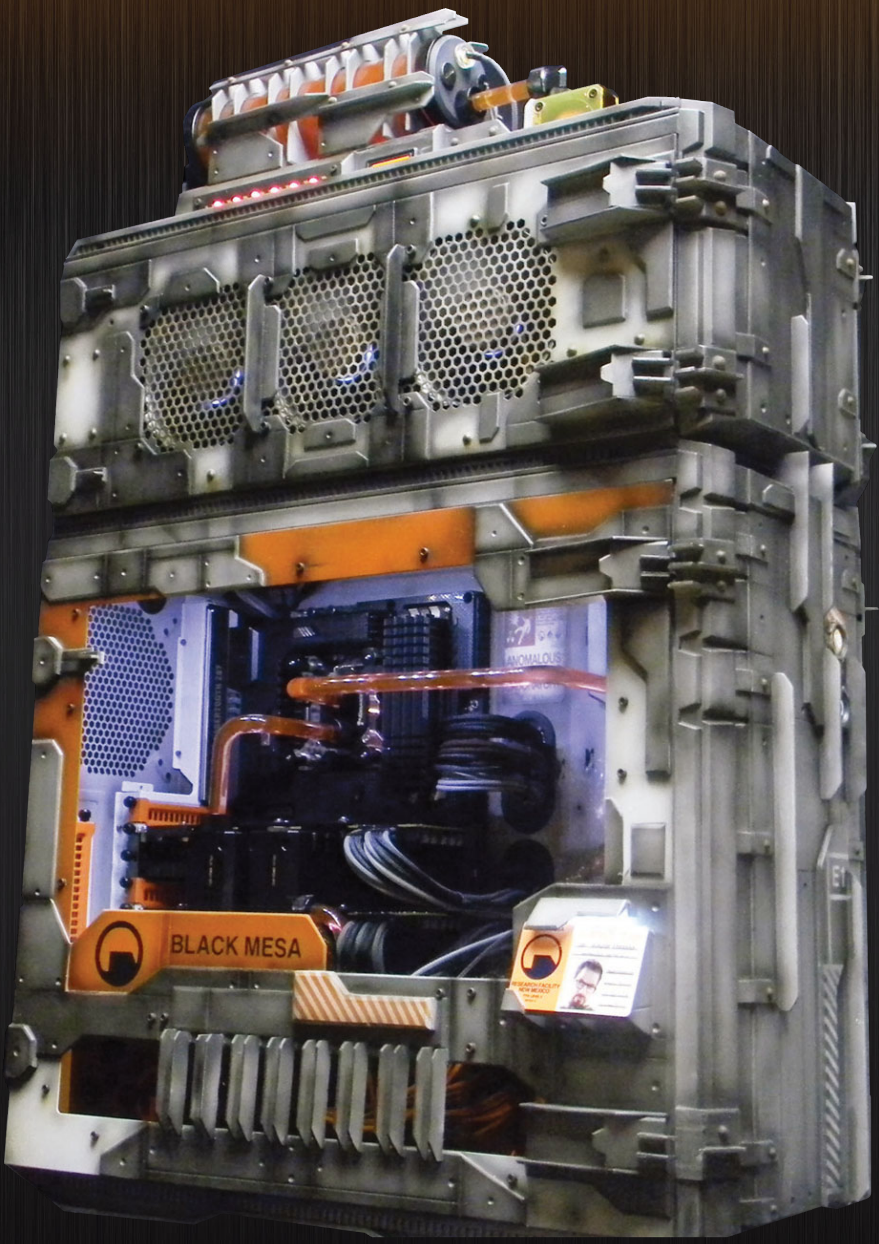


Half-Life Black Mesa

At PDXLAN 21, Ron L. Christianson had to settle for third place in *CPU*'s mod contest. His mod, Biohazard, was a scratch build made to look like an Umbrella Corporation installation from the Resident Evil series (otherwise known as Biohazard in Japan, hence the name). A year later, Christianson returned to PDXLAN 23 with a vengeance, and a new mod. His latest work just happens to be another videogame tribute, and another reference to a shadowy corporation. This time, though, Christianson and his Half-Life Black Mesa mod would not be denied, taking home all the donuts—mystery finally solved—at our mod contest at PDXLAN.

Half-Life Black Mesa certainly looks like something that belongs in a subterranean lab at Black Mesa's facility, right down to a Gordon Freeman ID badge. Like Christianson's Biohazard mod, Half-Life Black Mesa is an example of what a master sculptor can do with a little styrene and a lot of hard work. This time around, though, Christianson already had a foundation for his massive mod: Cooler Master's HAF Stacker 935 tower (which coincidentally is reviewed elsewhere in this issue).

Built In A Blur

Most mods of Half-Life Black Mesa's size and detail are created over the course of several weeks, months, or even years. Not Half-Life Black Mesa—Christianson estimates he cranked out this jaw-dropping mod in just 25 to 35 days. In Valve terms, that's approximately 0.000425% of development time on Half-Life 3, give or take a few years.

"The project was built for Cooler Master and CES 2014," he says. "I had a very short deadline."

Half-Life Black Mesa did not begin as a government-backed skunkworks project, despite what our own fanciful notions would have us believe. Cooler Master approached Christianson at last year's PAX Prime about modding the company's new HAF Stacker 935 chassis for CES. The catch was that Cooler Master needed the case until the end of November. As you might know, CES always begins in early January, which gave Christianson a very tight timeframe to complete his mod.

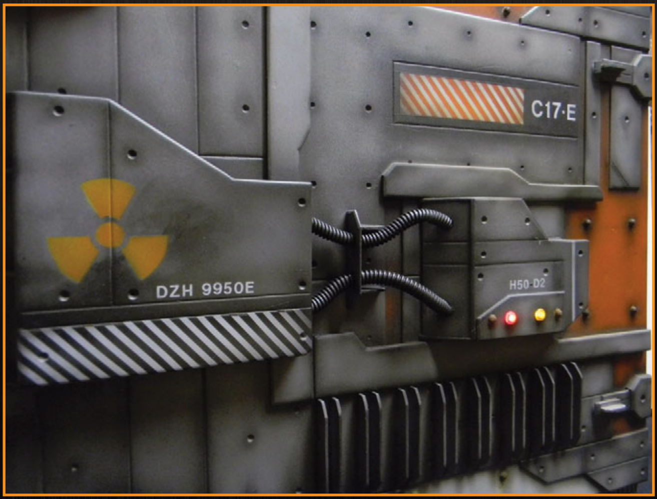
But when Cooler Master comes calling and asks you to CES, you don't say, "No." So Christianson, who is also a graphic artist and painter, got right to work in his basement workshop/studio as soon as the Stacker arrived.

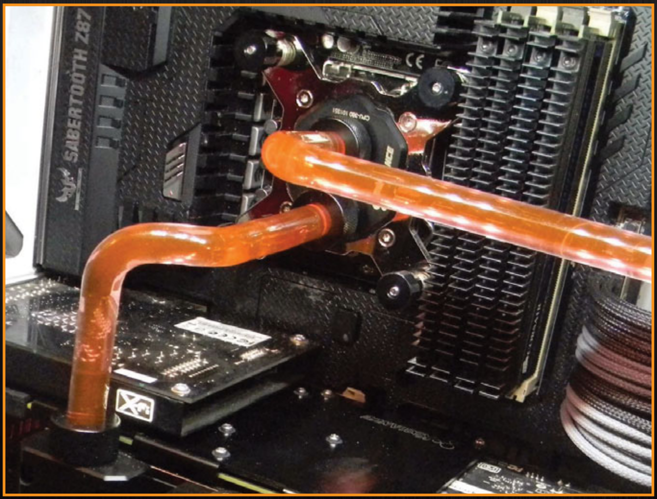
Wake Up & Smell The Styrene

The mod consists of plastics "of all sorts," ABS, and the aforementioned styrene. Christianson says he sculpted and sanded all of the mod's pieces with his own two hands.

"When I decided to do the Half-Life theme, I started with visualizing the project from the completed stage and worked backwards in my mind, making visual blueprints to work from," he says.

One of Half-Life Black Mesa's most eye-catching pieces is the reservoir Christianson built atop the Stacker. In addition to the reservoir, it also has a built-in fan controller, temperature sensor, and flow meter. He cut and modded the case window and





fashioned new panels in order to fully realize his vision of the Half-Life theme.

Christianson used the 915R, which sits on the Stacker's 935 main chassis, exactly as Cooler Master intends: It houses Half-Life Black Mesa's radiator. Christianson also removed the interior panels behind the front bezel, giving him quick and easy access to his fittings and fans whenever he takes off the front panel.

Inside, Christianson's mod has a mean set of specs. He's running an Intel Core i7-4770K on an ASUS Z87 SABERTOOH motherboard, with 16GB of Patriot Viper Extreme memory and two Kingston HyperX 3K SSDs. Half-Life Black Mesa boasts a pair of GeForce GTX 780s in SLI, and a Cooler Master Silent Pro Hybrid 1300W PSU keeps them well fed. The system's liquid loop consists of PrimoChill rigid tubing and Koolance waterblocks for the CPU and GPUs.

Wisely Done, Mr. Christianson

Half-Life Black Mesa joins Christianson's rapidly expanding lineup of exceptional mods. He's considering a scratch build based on a robot or droid but also reveals to us that he originally wanted to do a Titanfall build when Cooler Master first commissioned him for the Stacker mod.

Far be it from us to dictate TITANFALL Christianson's next mod TITANFALL to him, but Mr. Christianson TITANFALL, if you're taking requests TITANFALL, you have our TITANFALL number. ■

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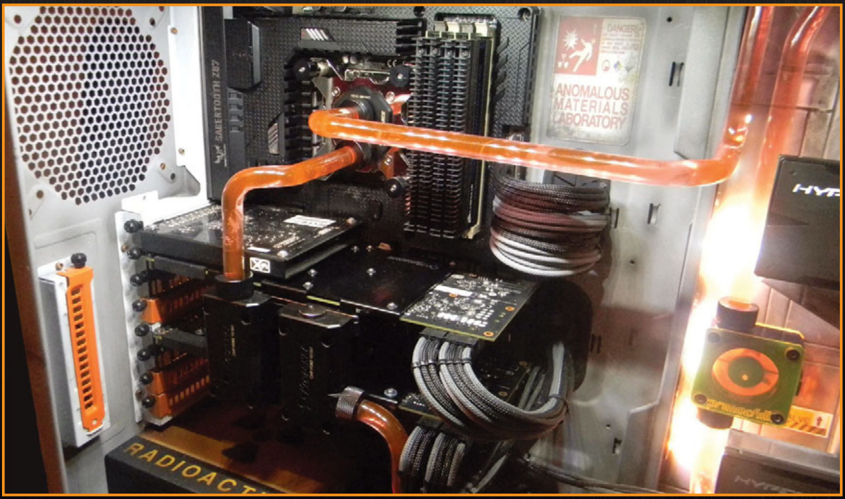

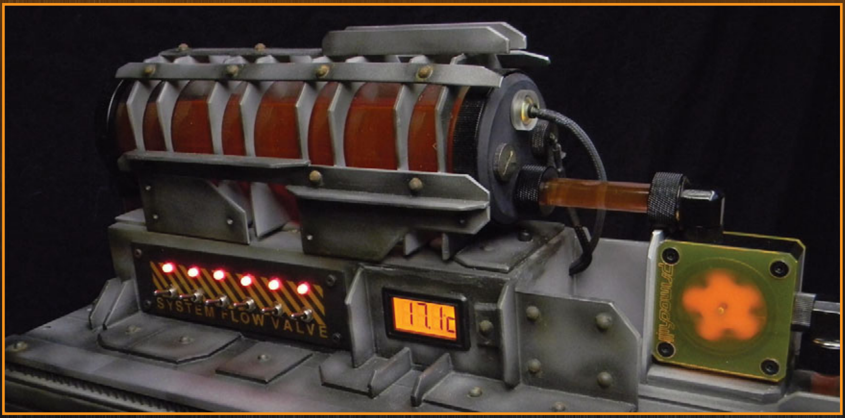
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Intel LANFest Series Closes Out 2013, Roars Into 2014

Time marches on, and so does Intel's LANFest series of LAN events, taking place across the country throughout the year. One of the last events of 2013, LANFest Austin Winter 2013, took place from Dec. 20 through 22 at Intel's campus on the west side of Austin, Texas. As the year waned and 2014 was coming to the end of its first month, we attended LANFest NETWAR 26.0 at the Scott Conference Center in Omaha, Neb. And in March, LANFest held an event complete with several contests and tournaments at the Interactive portion of SXSW, also in Austin.

LANFest Austin Winter 2013

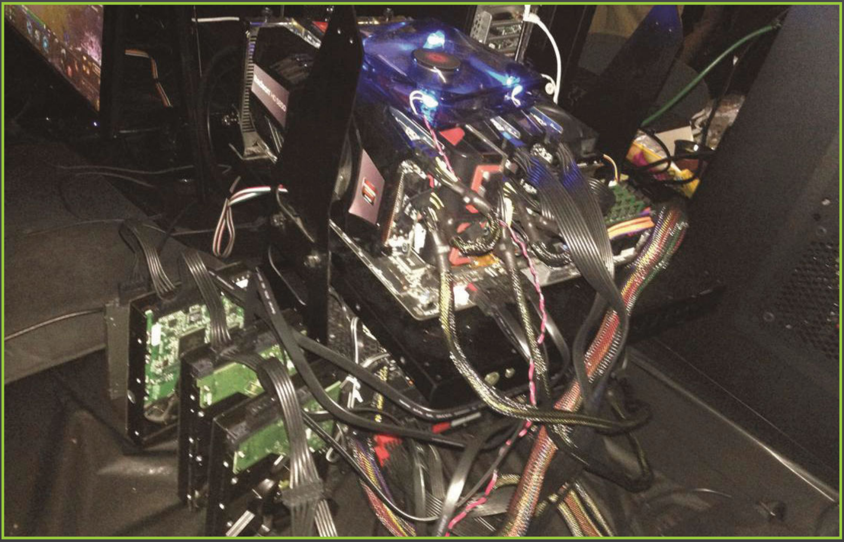
The most recent LANFest Austin event was the first to take place in Intel's new campus, which conveniently enough, is located directly across the MoPac Expressway to the west of the old one. As you can see, the mood at the event was festive, and Intel's new facility has a pretty nice cafeteria.

LANFest NETWAR 26.0

As the LANFest event that's closest to home for *CPU* staffers, NETWAR usually draws a few of us who attend in an unofficial capacity, and NETWAR 26.0 was no exception. NETWAR is a shorter event than some on the LANFest schedule; it generally begins at 6 p.m. on a Friday night and runs through 9:30 p.m. the following evening, for a total of 27.5 hours. But they are quality hours!

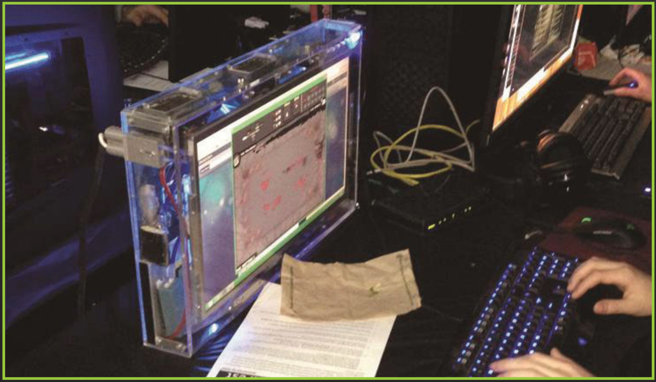
NETWAR Mod Contest

We found some cool rigs at NETWAR 26.0, but the winner of our mod contest was fairly . . . well, we suppose you could characterize it as "nontraditional." At a glance, this looks like an unruly pile of PC components that has just been arranged in close proximity on a LANFest table in lieu of packing them into a case. As is often the case, however, there's more to this system than meets the eye: This is a Linux machine set up to run several virtual machines from one motherboard, with the ultimate goal of running an entire DOTA team from one system.



As you can see, the team had to settle for three players on one box (note the number of hard drives and video cards attached to the computer) because of some issues they ran into the day of the LAN. Still, though, when you consider that the owner of the system wrote his own code to get three VMs running and to get the system resources allocated properly, it's a pretty impressive feat of engineering.

"She may not look like much, but she's got it where it counts, kid." (OK, that's not acutally what our winning modder said as he received his trophy.)



There were other cool rigs at the event, as well, including these beauties, which may look familar. . . .

LANFest SXSW 2014

LANFest's SXSW event was part of the Interactive portion of SXSW, and included several tournaments and contests, as well as a prize raffle. The event was open from noon on Friday, March 7 through 10 p.m. on Sunday, March 9.

LANFest SXSW gave attendees a chance to compete in Hearthstone: Heroes of Warcraft, Chivalry: Medieval Warfare, Minecraft, League of Legends, Kerbal Space Program, and more.

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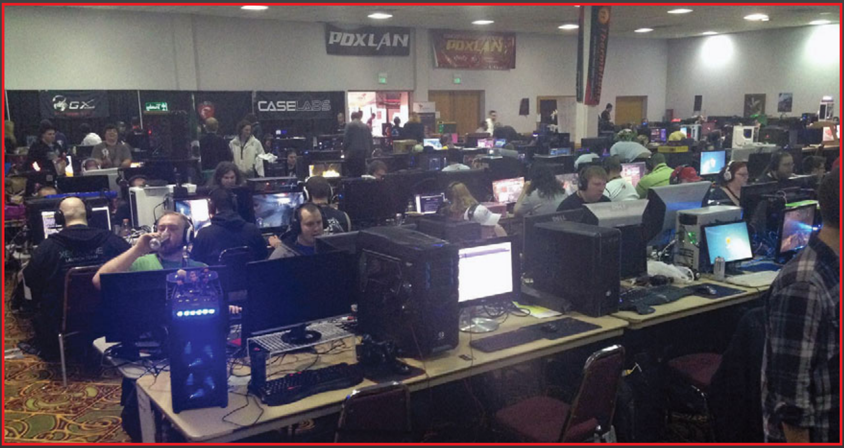
PDXLAN 23

Gamers Invade Portland

This winter, as the East Coast and much of the Midwest found itself gripped in the throes of a polar vortex, a storm of a different kind rolled into the quiet city of Portland, Ore. On Friday, Feb. 21 at 6 p.m., hundreds of eager gamers blew the doors off the PDX Holiday Inn's convention center to convene PDXLAN 23. The event, one of the oldest and largest in the Pacific Northwest, was sold out yet again, with 550 LAN warriors pitched in battle for three days.

Tournaments were plentiful, whether attendees wanted to slug it out in games like League of Legends and Battlefield 4 or if they wanted to go AFK for a while and compete in one of PDXLAN's many offline competitions. Some of the contests that might classify as "Other" included a LEGO challenge, Zombie Dice, and bocce. Also, as is the norm, Team *CPU* was on hand to judge an impressive field of case mods; we also gave away a slick rig known 'round CPU HQ as the Glass Cannon.

These gamers gave back, too. PDXLAN raised $23,000 for the Phil Scholz Memorial Foundation. Scholz, a marketing manager for NVIDIA, was tragically killed rescuing a man from tracks of the Caltrain Santa Clara station. It was a heartfelt way for PDXLAN attendees to use their collective power for good. Well done, guys.

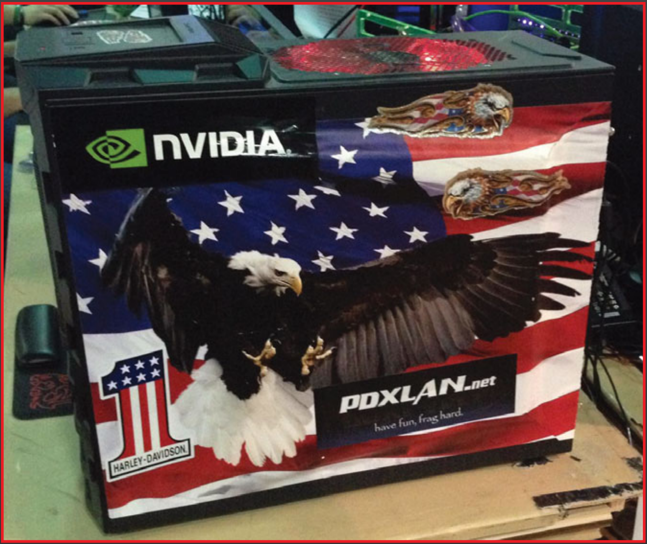


The LAN party becomes a block party. They may not be Master Builders (yet), but these LEGO challengers all put forth an effort that would make Emmet Brickowoski proud.

LAN parties happen to be a natural habitat for all types of plush fauna, and this PDXLAN was no exception.

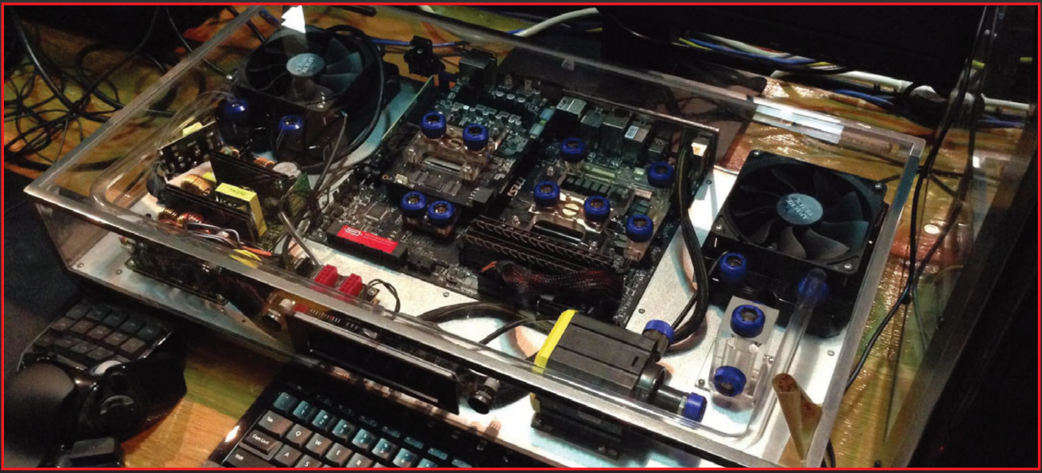
Not every PDXLAN attendee walked in with one system and walked out with two, but once he won our Glass Cannon build from the February 2014 issue's *CPU* System Workshop, Scot McDonald wasn't every PDXLAN attendee. He took home one of the sharpest builds we've ever done. Congratulations, Scot!

Richard "DarthBeavis" Surroz delivers a presentation on pipe bending. Surroz and other luminaries in the modding community were on hand for PDXLAN's Mod Garage, which included three charity PC builds as well as tutorials on a variety of modding topics.



Stephen Colbert was a no-show, but his gaming PC made it.

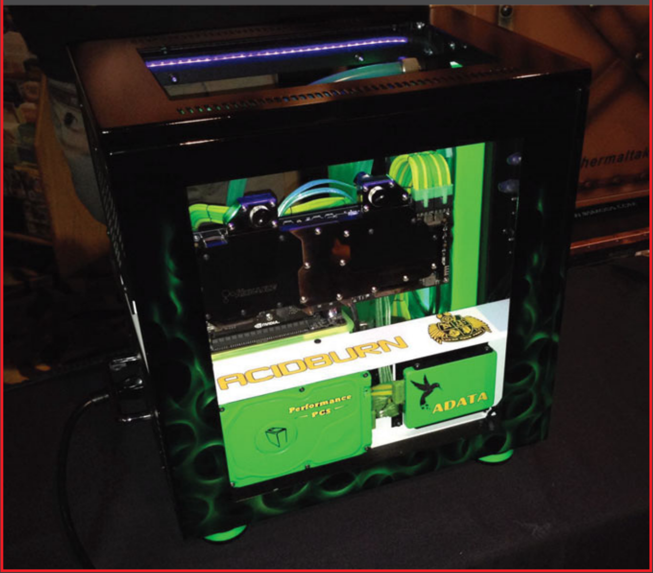
Remember this mod a few months from now; we wouldn't be surprised in the least if it found its way to a mod contest podium in the near future. Nearly everything is custom, as you might imagine, including the acrylic panels, waterblocks, and riser cards.



Mega Mods

The number of quality mods on display at PDXLAN is, in a word, ridiculous. These guys love to mod, and it's virtually impossible walk down any row at the LAN party without seeing at least a couple of modded PCs. It doesn't make judging any easier, but it certainly makes it more fun.

This time around, Ron Christianson's Half-Life Black Mesa mod emerged the winner. Christianson is no stranger to videogame tribute mods (his Biohazard mod, based on the Resident Evil franchise—aka Biohazard in Japan, finished third at PDXLAN 21), and Black Mesa is everything a Half-Life mod should be. See for yourself in this month's "Mad Reader Mod."

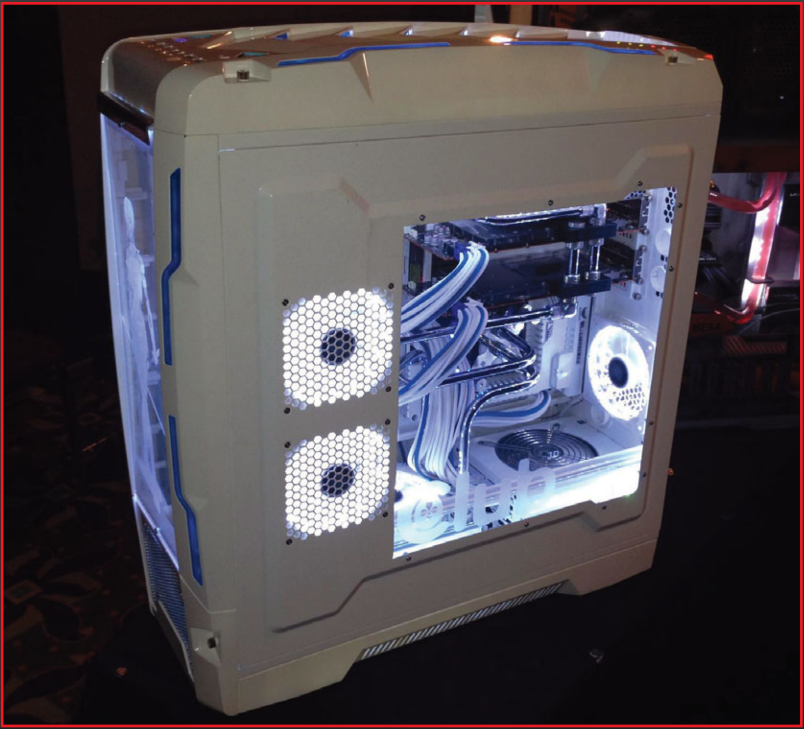


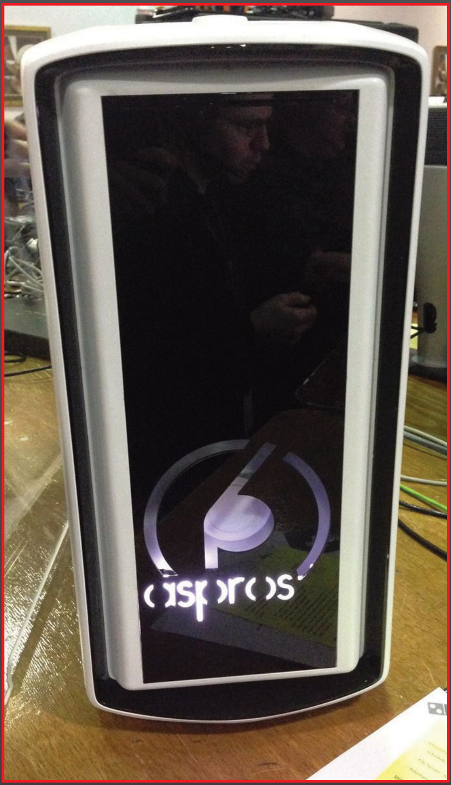
2nd Place: ACIDBURN

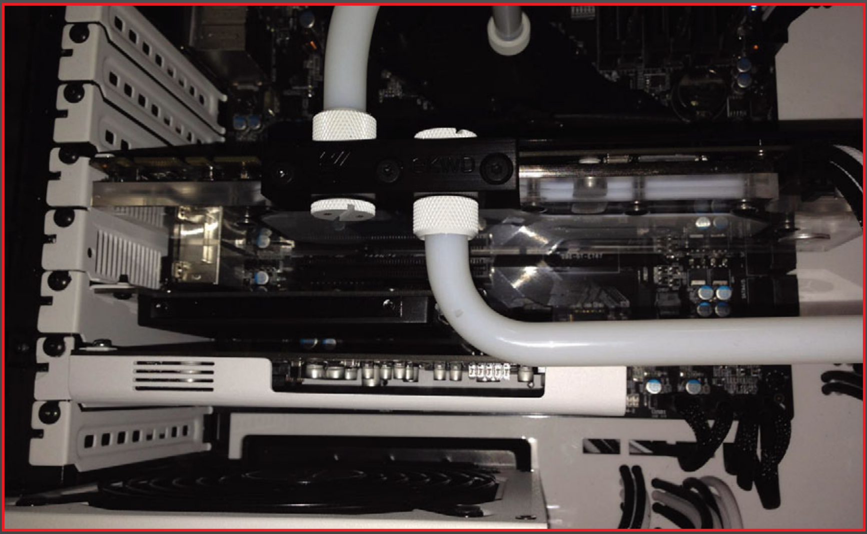
A year ago Jon "Pennywise" Hansz's Triton mod took home the first-place trophy at PDXLAN 21's mod contest. The bar can't be set any higher, and considering PDXLAN's stacked competition, a second-place finish for ACIDBURN is nothing to be ashamed of. We liked ACIDBURN, a modded CaseLabs Mercury S3, well enough at PDXLAN 22, and it was certainly a strong entry this time around, as well. There isn't a bad angle to this mod, and Hansz's custom wiring and liquid-cooling skills are on full display here.

3rd Place: White Lightning

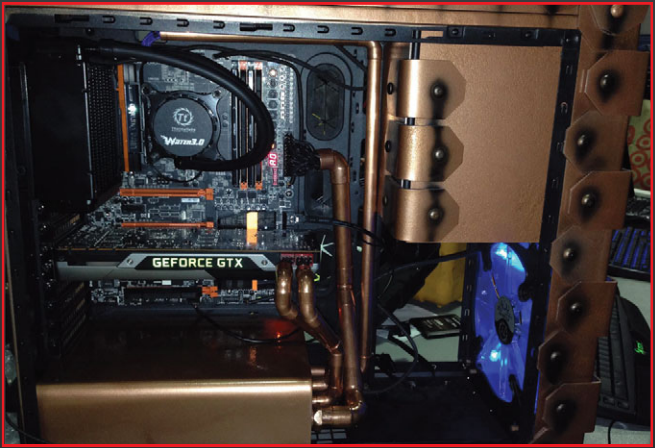
Like his NRP clanmate Hansz, Anthony "Elmy" Lackey, Sr. is no stranger to *CPU* and "Mad Reader Mod"; his White Lightning mod placed at PDXLAN 22, as well. Well, White Lightning is back again, striking this time in its perfected form. Some parts were white out of the box (like the ENERMAX case fans), while others required Lackey's modding acumen (like the ADATA SSDs and ASUS SABERTOOTH motherboard).





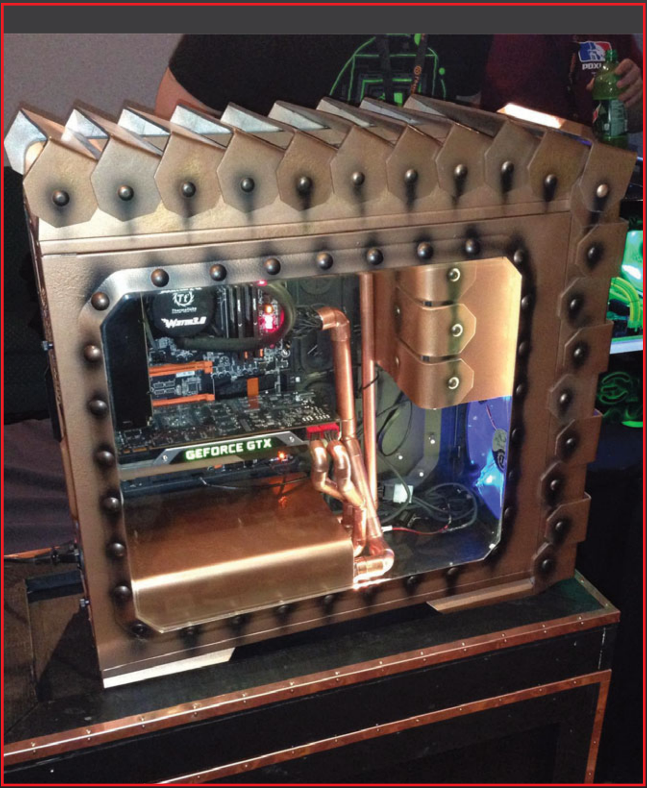


4th Place: Aspros. Apparently, white is the new black, as two of our top five went with white mods. Mike “Lutro0” Landenberger is well known in the modding community for his eponymous Lutro0 Customs, which is a one-stop shop for custom sleeving, so it shouldn’t come as a huge surprise that he’s a pretty good modder in his own right. Aspros, which is Greek for “white,” is based on a Corsair 600T White Edition case and has tons of custom acrylic work to go along with the white mods Landenberger liberally applied throughout.



5th Place: Vintage Armor

Don’t look now, but Rod “[TB]Rod” Rosenberg and Bob “BS MODS” Stewart are quickly becoming the Dynamic Duo of modding. These two have a number of stunning solo projects under their belts, but like their Throne Industrial mod that won PDXLAN 22’s mod contest, Vintage Armor is another Rosenberg-Stewart collabo. Inspired by “The Man in the Iron Mask,” Vintage Armor is a Thermaltake A71 case painted with hammered copper paint and then airbrushed with black. Quarter-inch aircraft rivets with half-inch heads complete Vintage Armor’s retro look.



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HTPC Multiplicity

For some, the purpose of a home theater PC is elusive in the age of smart TVs, web-enabled Blu-ray Disc players, Chromecast, home entertainment-centric gaming consoles, on-demand cable programming, and a dozen different streaming media boxes available for a pittance. These people can't imagine any experiences that they're missing out on by going with one or more of the above.

If you're reading this, however, you probably aren't one of those people. Neither are we, and the number of people who are beginning to realize the benefits of having a PC in the living room appears to be growing.

An HTPC can be many things, depending on the hardware under the hood, the software installed, and the peripherals attached. For instance, it can be a DVR for your cable or OTA (over-the-air) TV, a media server for your network, a music jukebox to fire up when entertaining guests, a Blu-ray Disc and DVD player, an enhanced stereo receiver, a TV-based web terminal, and an HDTV gaming rig. And of course an HTPC makes a great streaming video player for such services as YouTube, Netflix, Hulu, Amazon Instant Video, HBO GO, and so on.

The sky really is the limit when you build your own HTPC. (Well, that and your budget.)

This month, we hope to offer some insights into the process behind building the ultimate HTPC. Even if you already have an HTPC, this article might offer a few simple ways to upgrade and improve your current TV-computing experience by adding components and tweaking settings. And finally, if you are one of the aforementioned people who still don't see the point of a dedicated HTPC, perhaps we can convince you of the unbeatable value of plugging a PC into your TV.

Like Intel's NUC, GIGABYTE's BRIX barebones system makes a great HTPC foundation.

Every One A Snowflake

If you ask five enthusiasts what's in their HTPCs, you're likely to get five distinct parts lists. The way you use your entertainment center will play a big role in the components you choose for your system. If you strictly watch TV and movies, then make sure there's a TV tuner on your list. If you are a gamer, then a discrete graphics card is a must. If you're compulsive about social media, then an Internet connection is compulsory. For the most part, as long as you keep in mind the fact that you're going to be sitting significantly farther away from the screen than you usually sit from your PC or notebook, then there's really no wrong way to use an HTPC.

HTPC On A Shoestring

It's easy to look at the laundry list of ways an HTPC beats any so-called "smart" device that you can hook up to your TV, but not all of us are interested in purpose-building a PC for the job. Budget constraints are also a big reason you may be inclined to keep your computing confined to an office setting. But there are a number of ways you can take a shortcut and save money on your HTPC project without missing out on much.

In the March 2014 issue (starting on page 12), we took a look at Intel's Wilson Canyon-based NUC. This unit is packed into a box that's just over 4 inches square, yet is surprisingly capable. That's thanks to its 4th Generation dual-core 1.3GHz Intel Core i5-4250U processor with Hyper-Threading, Intel Turbo

As cool as they are, why settle for a Chromecast device when you can have an HTPC?

Boost Technology 2.0, and Intel HD 5000 processor graphics. All this adds up to a perfect little HTPC that even comes with a VESA mount so you can bolt it to the back of your HDTV. Just add a mini HDMI to full-size HDMI adapter, some SO-DIMM memory, a PCI-E full-mini card SSD, and a PCI-E half-mini card Wi-Fi adapter to turn this barebones system into a full-fledged PC. You can even connect one or more USB 3.0 external hard drives to beef up its media storage potential, and we highly recommend a wireless keyboard and mouse to complete the package. The consumer infrared sensor, which works with a variety of universal remotes, lets you perform many functions without having to haul out an unwieldy mouse and keyboard.

The NUC HTPC option is great for those with space constraints, but if your budget is the big roadblock, we recommend buying a used notebook that you can repurpose. You typically don't have to look far to find a used device; eBay and Craigslist abound with options, and even a fairly outdated model will offer plenty of home theater enhancements. To get an even bigger discount, look for notebooks with shattered or otherwise broken screens. These are costly components to replace, and many users would rather just spend the money on a new device than sinking money into a repair. For example, we did a "broken screen" keyword search in the computers category on our local Craigslist page and found a used Toshiba Satellite L645-S4102 for $50. The seller said the battery had been fried by lightning and the screen was shattered when it was stepped on while lying on the floor in a dark room. Even if the only thing worth salvaging is the Windows 7 license key, then this deal would be worth it.

Using a laptop for your HTPC is also a good idea because it can be easier to stack a thin device on top of other home theater equipment. But keep in mind that laptops can get fairly hot, and dust buildup can exacerbate this problem. We recommend making sure the laptop has lots of good ventilation or has a dedicated laptop cooler to help keep cool air circulating past its cramped components.

Another option that may appeal to budget home theater enthusiasts is a used business-oriented compact system, such as a small form factor Dell OptiPlex. These systems are small and built to last, and you can typically position them horizontally, which

Breathe new life into a used (or abused) laptop by making it an HTPC.

makes them easy to stack with your home theater equipment. Used models are readily available and in most cases won't cost you much; just keep in mind that your future upgrade options may be limited in such a scenario.

Finally, there's no reason you can't repurpose an older system that may not be able to keep up with the demands of serving as your main system. In the following section, we'll take a home-theater-centric approach to evaluating each component that makes up a computer. You can use this guide to help you determine which parts you'll want to refresh and which are "good enough" to salvage from an older system if saving money is your primary concern.

Concerning The Case

The enclosure of your HTPC is one of the components you really shouldn't skimp on. We tend to favor cases that feature a desktop form factor so you can slide it in among your home theater components. After a quick online perusal, we found a number of units designed to look like A/V receivers, or at the very least, to blend into the background. Some units come with backlit programmable VFDs with infrared receivers and bundled remotes, and a few even sport large receiver-style volume knobs on the front panel, which can be a nice touch.

Small form factor cases can work well for your HTPC, but remember that they tend to have limited motherboard support, typically narrowing your options to mATX- and Mini-ITX-sized boards. There are also low-profile cases available, but upgrading these systems can cause headaches due to the lack of support for full-height expansion cards. Pay particularly close attention to the size of the PSU bay, as you'll get more mileage out of a case that supports standard ATX PSUs. Cooling in your HTPC is important, but so is noise output. Favor cases with 120mm fans or larger to keep air moving but the rpms low.

This is the VESA mount bundled with Intel's NUC, which lets you mount the compact system to the back of your HDTV.

The Mother Of All HTPC Motherboards

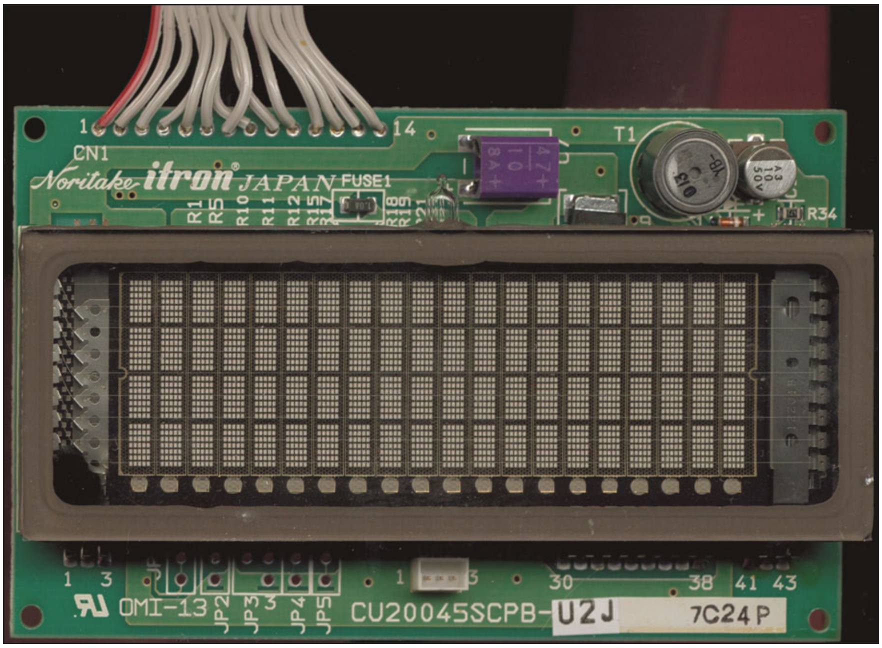
As we mentioned above, the size of your HTPC's motherboard may be limited by your choice of enclosure. The good news is that many current mATX-sized motherboards, which measure 9.6 inches square, are every bit as feature-rich as the larger ATX boards, which measure 12 x 9.6 inches. Most typically, you're only losing out on a few expansion slots by settling for the smaller board.

With Mini-ITX motherboards (6.7 inches square), your options are rather more limited. At best, you'll have just one expansion slot, which will most often be a PCI-E or PCI slot. Getting a motherboard with onboard graphics and built-in wireless (or support for a mini-PCI-E slot for a wireless module) can reduce the necessity for expansion slots. If you want to use your HTPC as a DVR for cable or OTA broadcasts, make sure the motherboard you choose provides at least one expansion slot for a TV tuner. Some Mini-ITX motherboards utilize SO-DIMM memory, which tends to cost more than desktop RAM per gigabyte.

Regarding audio, make sure the board supports at least 5.1-channel output. Ideally, the motherboard should support 192kHz, 24-bit Hi-Fi Blu-ray lossless and extreme fidelity audio. Although you can get acceptable audio performance from a digital optical port or even analog jacks, HDMI-based audio that supports HDCP (High Definition Content Protection) is the best option. If the Blu-ray Disc you're watching features content protections flags, any non-HDCP-compliant components between the media and your HDTV may downgrade the audio and visual fidelity of the playback. Furthermore, if you know in advance that you're going to be connecting your HTPC to a stereo or 2.1-channel sound system, look for audio chips that support virtual surround sound technologies, such as DTS TruSurround.

If 3D video is important to you, then make sure your motherboard and HDMI cables all support HDMI 1.4b or newer. If you're planning to upgrade to a 4K HDTV in the relatively near future, the make HDMI 2.0 your baseline; it supports 4K resolutions at 60 frames per second.

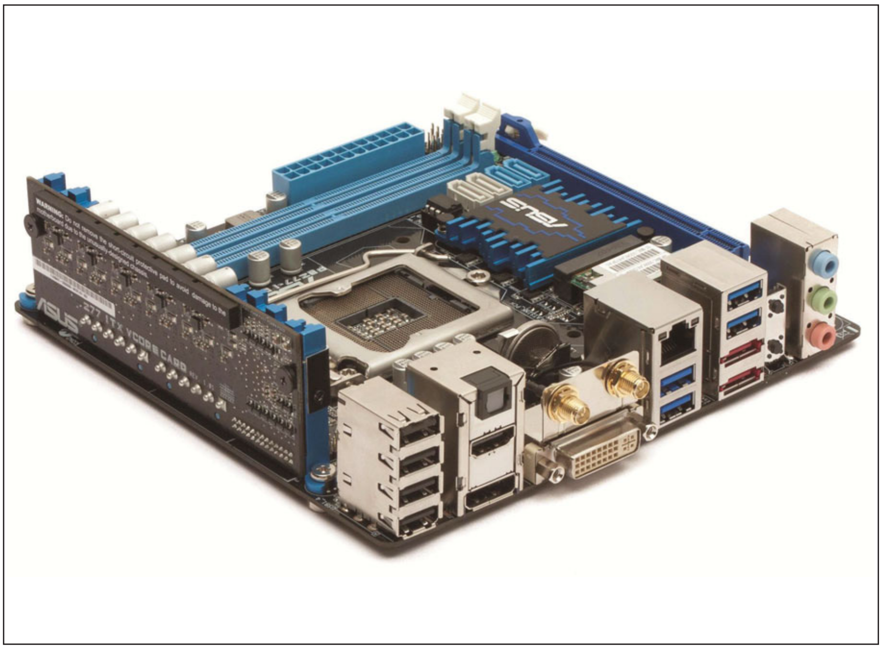
It's also a good idea to look for a motherboard that offers a bevy of USB ports; USB 3.0 ports will make a big difference if you plan to connect external storage devices.



A VFD like this one can give the front panel of your HTPC some added flair.

A Picture-Perfect Processor

AMD and Intel both offer a variety of processors that work well with home theater applications, although your choice of motherboard will be a major determining factor. The key here is to look for a multi-core processor that's fairly low-power. Although the 130-watt Intel Core i7-4960X Extreme Edition processor or AMD's 220-watt eight-core FX-9590 are capable of decoding a dozen HD video streams simultaneously, they'll generate a lot of heat and the cooler you'll have to install may be noisier than you'd like.



Mini-ITX motherboards, like this one from ASUS, can be surprisingly feature-packed.

From Intel, a Core i3, i5, or i7 Haswell processor that starts in the 65-watt TDP (thermal design power) range will offer plenty of muscle, but without a lot of excess noise and heat. Furthermore, these processors feature Intel HD or Iris Pro graphics, which can handle 2D HD video with ease, and in many cases can even support a casual gaming habit. More specifically, the Core i3-4130 and 4130T both come with on-die Intel HD 4400 (GT2) graphics, which features 20 execution units, a base frequency of 350MHz and a max dynamic frequency of 1.15GHz. It also supports Intel Quick Sync Video, InTru 3D Technology, and Clear Video HD Technology. To put these technologies into more generic terms, these processors support dedicated media encoding hardware; 3D content playback; decode acceleration for AVC, VC1, and MPEG-2; support for HDMI 1.3 and dual simultaneous HDMI; and bit-streaming Dolby TrueHD and DTS-HD Master Audio.

From AMD, an FX processor is probably overkill, but the A10, A8, A6, and even A4-based processors are more than capable as the CPU of an HTPC. These chips also come with on-die graphics from the Radeon HD 8000 and 7000 families, which will typically deliver quality gaming performance and excellent HD video performance for your home theater. To use the A4-5300 and A4-4000 as a baseline, these APUs feature Trinity graphics, in this case also known as the Radeon HD 7540D GPU, which is composed of 128 stream processors, eight texture units, and four ROPs. It also features hardware decoders for Adobe Flash, H.264, MPEG-2 (SD and HD), MPEG-4 Part 2 (for DivX and Xvid video), MVC, and VC-1.

Often, the CPU cooler you strap to your HTPC can become loud enough to hear between the explosions of sound emanating from your speakers, so spend some time looking for an aftermarket heatsink that has large (but not too large) and quiet fans.

The Graphics Card Question

Running a discrete graphics card in your HTPC is entirely optional. For the core home theater applications, such as HD video, multichannel surround sound, and streaming media; a graphics card brings little to the table. If you want to do any gaming, however, you'll be able to tell a difference between the performance you get with a discrete graphics card and processor- or integrated motherboard-based graphics. If you decide that you want to bring your PC gaming to your HDTV, you're in good company; Valve's Steam Machines are attempting to do just that.

Current-generation graphics cards from both NVIDIA (since the GeForce GT 430) and AMD (since the Radeon HD 5000 Series) support bitstreaming Dolby TrueHD and DTS-HD Master Audio for Blu-ray. These audio formats are the Holy Grail for home theater enthusiasts. As we went to press, the slightly older AMD Radeon HD 6450 and NVIDIA GeForce GT 530 were available for between $40 and $50 each.

If gaming is particularly important to you, then we recommend setting your sights on the latest families of GPUs from AMD and NVIDIA, keeping in mind the importance of noise and heat output. If your case is already rather compact, a discrete graphics card like the Radeon HD 6450 or GeForce GT 530 will have little impact on your system's temps and noise levels. When looking for a more powerful graphics card, choose one that has a fully enclosed heat shroud, such as a reference design graphics card. Most cards with aftermarket coolers and overclocked core clocks feature open heat shrouds, which will dramatically increase your internal case temperatures, even when you're not gaming. Cards we recommend include the Radeon R7 260X and the GeForce GTX 750, both of which can be had for around $150.

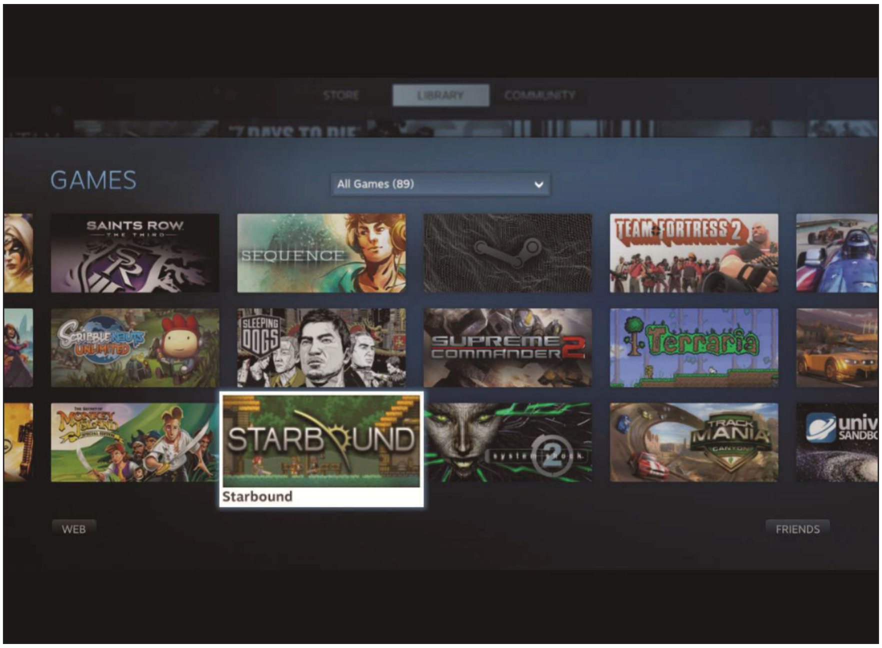
A closed heat shroud can reduce the amount of excess heat you're dumping into your system.

A TV Tuner For A DIY DVR

A TV tuner in your HTPC is generally considered optional, but we'd argue that you're sacrificing a lot of entertainment options by leaving it out. If you subscribe to a cable or satellite TV service, a TV tuner that accepts clear QAM (quadrature amplitude modulation) digital signals will let you record shows and movies to the HTPC's hard drive and time-shift them to your heart's delight. If you're a cord cutter, you can purchase an inexpensive OTA HDTV antenna (you can currently find these for around $50) to get access to your local channels in glorious 1080p. If you spring for a TV tuner with two or more tuners, you can record multiple programs at once. If you do decide to get a TV tuner, make sure you beef up the amount of internal storage you plan to install; just one hour of HD programming can consume several gigabytes. To access a programming guide that can make the HTPC run like a dedicated DVR machine requires some extra software, which we'll discuss shortly.

The Wired/Wireless Dilemma

There's no question that you'll want to make sure your HTPC has network access, but you will have to decide



Steam's Big Picture Mode is a 10-foot-UI designed for navigating from your sofa.

whether it will be wired Ethernet or Wi-Fi. If your entertainment center is near your router, then we recommend going the Ethernet route; it's inexpensive, has more than enough bandwidth headroom to support HD video streaming and online gaming, it's reliable, and secure. If your router's rather distant, you can retain many of these benefits using a powerline networking kit, which uses the copper power lines already snaking behind your walls to route packets between the Internet, your network, and the HTPC.

Wi-Fi is a convenient option, but to make sure you have the bandwidth to handle HD video and gaming, you'll want to use an 802.11n (or newer) adapter and router and make sure the signal remains strong at your HTPC. A range extender can help boost bandwidth if your home theater system lives in a dead spot in your home.

An Optional Optical Drive

Another feature we wouldn't hesitate to add is a Blu-ray Disc optical drive. You can save money by getting a BD read-only (BD-ROM) drive, which can render a standalone Blu-ray player utterly redundant.

A Middling Amount Of Memory

The speed of the memory you populate your DIMM slots with will be determined by the motherboard you select, but don't pour a bunch of money into getting overclocked sticks with tight timings. You'll get more mileage out of upgrading from 4 to 8GB than you will going from DDR3-1600 to DDR3-2400. Memory that has been validated for your motherboard is guaranteed to work, but we've run non-validated memory with a variety of motherboards and have rarely run into problems.

The Keys To The Car

The primary factors when choosing HTPC input devices include finding a wireless keyboard and mouse that work well from 10 feet away and that look good when not in use. Yes, we're wired mouse and keyboard snobs for our gaming rigs, but cables have no place in our ideal living-room computing scenarios. Both RF and Bluetooth-based devices work well. You can also purchase an IR receiver and remote control to perform various media-center functions, letting you store your mouse and keyboard out of sight for a majority of the time. There are also some pretty nice keyboard and touchpad combo devices out there that cut down device clutter and work passably for the simple navigation and occasional typing you'll likely end up performing on your HTPC.

HTPC Software & Settings

The operating system you choose should ideally have the ability to handle as many media formats as possible, or at the very least, support the installation of missing codecs quickly and easily. Windows 7 and 8, Ubuntu, and other media-centric flavors of Linux can be used as the foundation for a full-featured HTPC. Windows 7 Home Premium includes Media Center features, which you'll be able to use to access the local TV listings if you decided to install a TV tuner. Windows 8 users can also access this feature, but they'll need the Media Center Pack ($9.99) add-on to make it work.

If you're interested in the budding SteamOS, you can visit store.steampowered.com/steamos/buildyourown and click the link to download the default or custom SteamOS beta installation, then just follow the provided instructions to install it. To get a small idea of what to expect with SteamOS, you can install Steam and run it in Big Picture Mode. (For more information on installing the SteamOS beta, see this issue's installment of "Software Tips & Projects.") Similarly, various media playback applications currently available support a 10-foot UI designed specifically for use in a home theater environment, though your mileage with these will vary.

The Ultimate Entertainment Center

Typically, when someone refers to their TV and stereo as their "entertainment center," they're being a bit hyperbolic. But if you've built your own HTPC as we've described it, there's really no audio visual stimulus that the system won't be able to deliver in all its HD glory. So what are you waiting for? Start popping popcorn! ■

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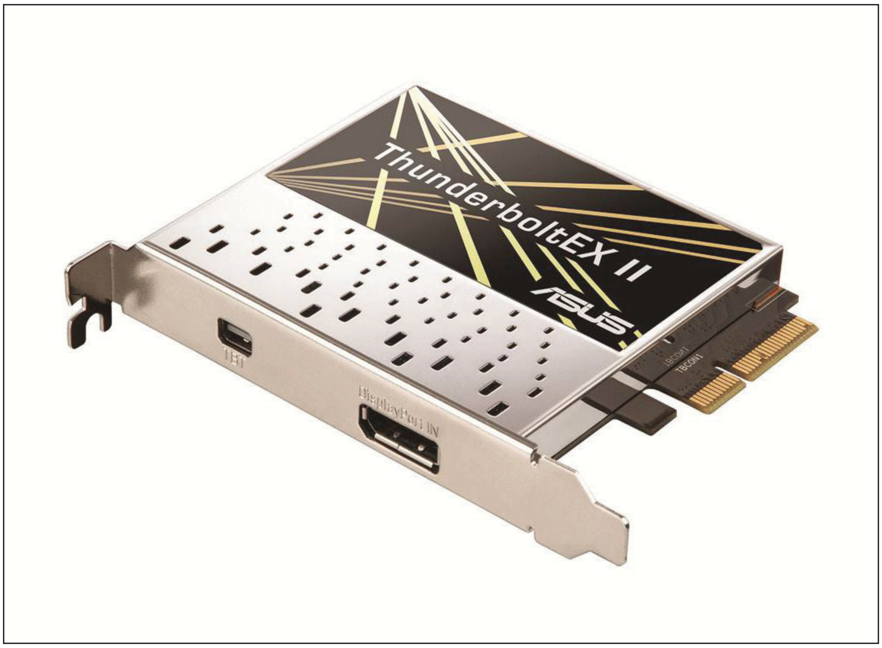
Work easy, play hard Windows 8

Thunderstruck

ASUS Brings Thunderbolt 2 To Your PC

At *CPU*, we love to check out new technology, and our interest is piqued by components that represent a big leap forward in performance and features. Thunderbolt 2 offers the kind of performance that promises to change how we work with our PCs. It's twice as fast as the first-generation Thunderbolt—jumping from 10Gbps to 20Gbps—and serves as a means to connect PCs to 4K displays and high-performance external devices, such as external RAID arrays.

ASUS recently released ThunderboltEX II, the world's first Intel-certified Thunderbolt 2 add-on card. The ThunderboltEX II works with a wide variety of existing ASUS Z87-based motherboards, and it's an easy way to add Thunderbolt 2's groundbreaking performance to your rig. ASUS sent us a ThunderboltEX II and its Z87-PRO motherboard so that we could take the new interface for a spin.



The ThunderboltEX II adds Thunderbolt 2 support to select ASUS motherboards.

What's New With Thunderbolt 2

Clearly, 20Gbps is much faster than the external I/O interfaces most of us have on our systems. Thunderbolt 2 is up to 40 times faster than USB 2.0 and four times faster than USB 3.0. The bi-directional 20Gbps speed provides the bandwidth necessary to enable new possibilities for video creators when storing and displaying video. For instance, Thunderbolt 2 can simultaneously transfer and display 4K video files, so you could be backing up the ultra-high resolution video while viewing it. You'd just need to daisy chain a high-speed RAID array and ultra-high resolution monitor to your PC.

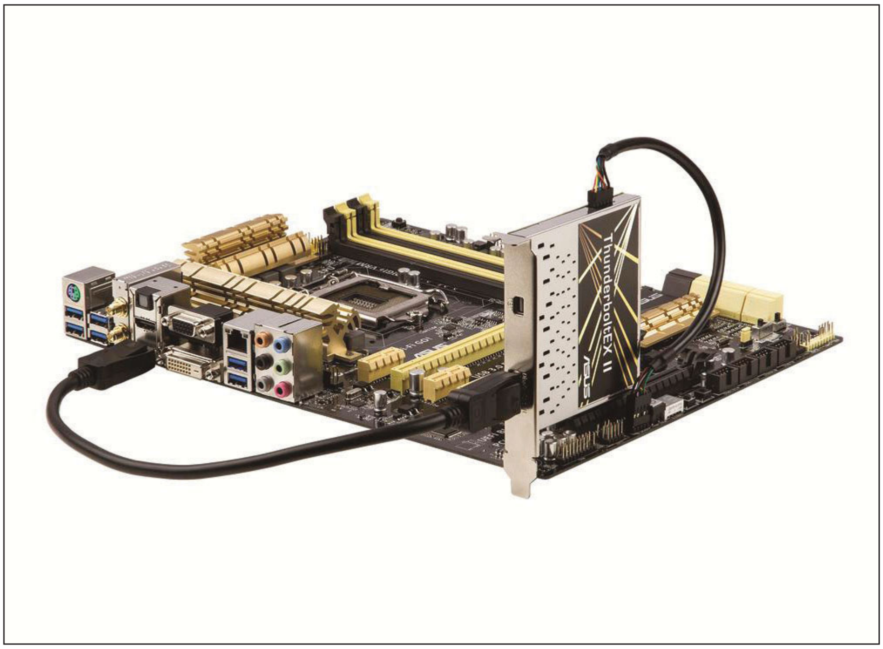
Intel made the speed increase to 20Gbps possible by reallocating the bandwidth of the original Thunderbolt design, which includes four 10Gbps channels. Thunderbolt 2 has the same overall 40Gbps bandwidth, but it's now split into two 20Gbps channels. For those that frequently transfer large files, such as photo and video enthusiasts and digital content creators, Thunderbolt 2's speed could dramatically reduce file transfer time and simplify workflow.

With Thunderbolt 2, you can daisy-chain up to six Thunderbolt devices, plus hook up a DisplayPort monitor behind the last Thunderbolt device. The speedy interface is also compliant with DisplayPort 1.2's Multi-Stream Transport capability, so you could connect up to three 1080p displays to a single Thunderbolt 2 output. (Note that daisy-chained 1080p monitors must all support DisplayPort 1.2, and there can be no legacy Thunderbolt devices connected between the Thunderbolt 2 host and the monitors.)

Like the original iteration of Thunderbolt, Thunderbolt 2 supports the bi-directional routing of PCI-E data. One exciting potential application of Thunderbolt 2 could be connecting external GPUs, though we've only seen a few prototypes of such a configuration thus far. With a Thunderbolt 2-connected external GPU, for instance, you could have a single, high-performance GPU that could quickly and easily be switched between your desktop PC and laptop.

Easy Upgrade

The ThunderboltEX II from ASUS is an add-on card that provides your rig with one Thunderbolt 2 port and runs Intel's DSL5320 Thunderbolt 2 controller. The add-on card can be installed into a PCH-connected PCI-E 2.0 x4 slot, and ASUS gave the ThunderboltEX II a half-length



The DisplayPort input allows the ThunderboltEX II to relay display data from your GPU.

design to prevent it from blocking a nearby GPU's fan intake.

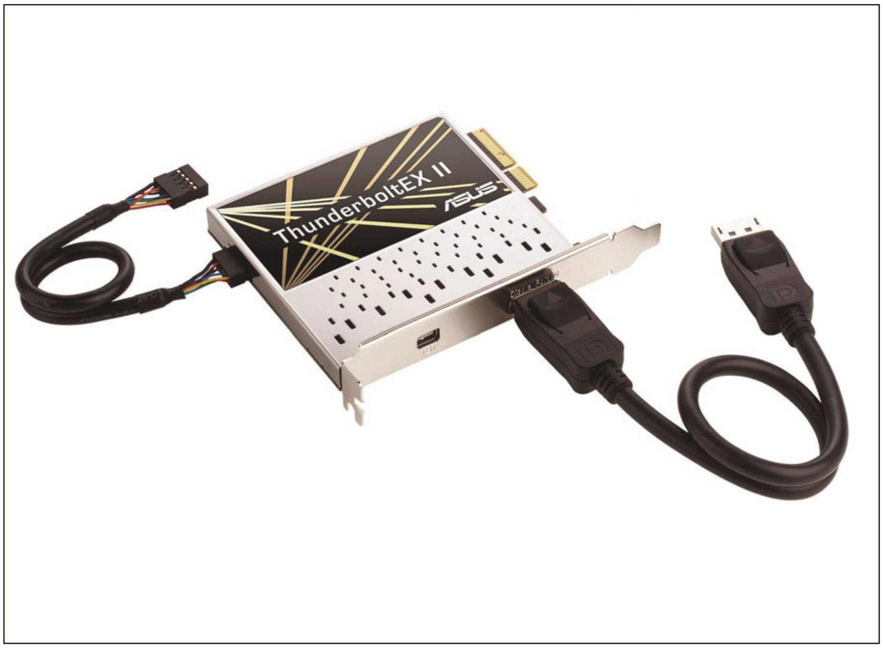
Installing the ThunderboltEX II is simple. Shut down your PC, open your case, and insert the card into a free PCI-E slot. You'll want to choose a slot that works in x4 speeds or above to ensure access to Thunderbolt 2's full bandwidth. Fortunately, a complete list of recommended slots for ASUS motherboards is provided in the card's user manual. Next, connect the included ASUS TB_Header cable from the ThunderboltEX II card to the TB_Header port on your ASUS motherboard. Finally, connect the included DisplayPort cable from the DisplayPort output on your motherboard to the DisplayPort input on the ThunderboltEX II. You can now connect your Thunderbolt and DisplayPort devices to the Thunderbolt 2 port on the add-on card.

ASUS Z87-PRO

As impressive as Thunderbolt 2 is, you'll likely want to pair it with a powerful PC that can handle all your enthusiast tasks. The ASUS Z87-PRO is strong base for a performance rig. It supports today's newest Intel Haswell processors, quad SLI (with dual-GPU cards, such as the ASUS ROG MARS 760) and 3-way CrossFire, and DDR3 clocked at up to 2933MHz. ASUS goes the extra mile to let you optimize this high-end technology too; the included AI Suite 3 utility lets you overclock your CPU, manage system voltages, control fan speed, and turn off extra I/O connectors. The utility can even automatically detect and tweak settings for you. For example, ASUS Fan Xpert 2 can optimize fan speed settings based on the known specifications and locations of the fans within your case.

The board's Wi-Fi GO! feature lets you use a smartphone or tablet to remotely manage and stream content from your desktop PC. To do this, ASUS builds a Wi-Fi GO! card onto the motherboard that works with the free Wi-Fi GO! Remote app. Through the app, you can view your computer's desktop and remotely operate the PC in real-time from your mobile device. You can even use the mobile device's touchscreen as a remote keyboard and mouse. Another handy feature of Wi-Fi GO! Remote is the ability to transfer files between your computer and mobile device. The Wi-Fi GO! card on the motherboard can serve as a wireless LAN adapter for your PC or an access point for other wireless devices.

Overclockers will like that ASUS includes a dedicated BIOS access button, labeled "DirectKey" that lets you enter the BIOS when the PC is in Standby mode. This



A 9-pin cable runs from the Thunderbolt header on the add-on card to the internal Thunderbolt header on your ASUS motherboard.

feature is ideal for exceptionally fast-booting Windows 8 systems that give you only a brief moment to press your BIOS access key during startup. Enthusiasts that plan on overclocking their memory will also like that the Z87-PRO also offers a MemOK! button that lets the PC load and test failsafe memory settings. Once loaded, should your system fail to boot after making a change to your memory, just press the MemOK! button again, and the system will load the failsafe settings.

Z87-PRO BENCHMARK RESULTS

3DMark Professional (Fire Strike Extreme)	**4667**
Graphics Score	4860
Physics Score	10505
Graphics Test 1	26.04
Graphics Test 2	17.78
Physics Test	33.35
Combined Test	10.19
PCMark 8 Creative Score	**4321**
SiSoftware Sandra 2014 SP1 Lite	
Processor Arithmetic	
Dhrystone AVX2 (GIPS)	148.3
Whetstone iSSE3 (GFLOPS)	101.46
Processor Multi-Media	
x32 Multi-Media Integer AVX2 (Mpixels per second)	422.79
x16 Multi-Media Float FMA3 (Mpixels per second)	355
x8 Multi-Media Double FMA3 (Mpixels per second)	204.5
x8 Multi-Media Float/Double FMA3 (Mpixels per second)	269.46
Memory Bandwidth	
Integer Memory Bandwidth B/F AVX/128 (GBps)	26.56
Floating Memory Bandwidth B/F AVX/128 (GBps)	26.56
Cinebench 11.5 CPU Score (points)	**8.23**
POV-Ray 3.7 Beta (pixels per second)	**1603.45**
Games (fps at 2,560 x 1,600)	
Metro: Last Light (16xAF; SSAO off)	45.83
Aliens Vs. Predator (8XAA, 16xAF)	48.7

The Z87-PRO also incorporates a number of technologies designed to ensure the long, reliable life of the motherboard and, by extension, your other components. ASUS' "5X Protection" includes a DIGI+ VRM (voltage regulator module) digital power design to ensure that your CPU receives precise power and overcurrent protection for your memory, among other things. ASUS uses high-quality solid-state capacitors that are tested at 105 degrees Celsius and have a rated lifespan that is 2.5 times longer than what you'll see with traditional capacitors. In short, we don't expect you'll be dealing with many issues, but ASUS backs the board with a three-year warranty just in case.

ASUS covers all the bases for external I/O connectivity with the Z87-PRO. The USB 3.0 ports utilize ASUS' USB 3.0 Boost technology, which can boost transfer speeds up to 170% for compatible USB 3.0 peripherals. There are a total of eight USB 3.0 ports (six on the rear panel, two via internal header) and eight USB 2.0 ports (via internal header). Of course, you'll also be able to add the ThunderboltEX II for Thunderbolt 2 external device compatibility. For internal storage connectivity, ASUS augments the six 6Gbps SATA ports driven by the Z87 chipset with an ASMedia 6Gbps controller that adds another two, for a total of eight SATA ports.

The ASUS ThunderboltEX II is also currently compatible with the MAXIMUS VI EXTREME, SABERTOOTH Z87, Z87-PLUS, and Z87-A motherboards, and ASUS says that more compatible models are on the way.

Speedy Results

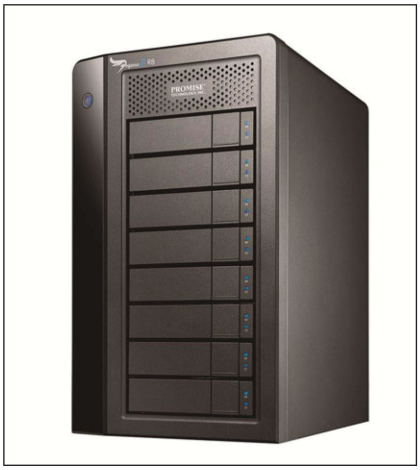
In order to test the performance of the ThunderboltEX II, we installed it on the Z87-PRO and then connected a 24TB Promise Pegasus2 R8 configured for RAID 5. The resulting benchmark numbers are astounding. In some sequential read and write tests, numbers topped 1000MBps. For instance, ATTO Disk Benchmark delivered a maximum read speed of 1366MBps and a maximum write speed

The ASUS Z87-PRO supports the Intel's Haswell processors, multiple GPU configurations, and DDR3 memory at up to 2933MHz.

of 860MBps. In SiSoftware Sandra 2014 SP1's File System Bandwidth test, we saw a read bandwidth of 682.21MBps and a write bandwidth of 1000MBps. In CrystalDiskMark, the Pegasus2 R8 produced a sequential read of 731.5MBps and a sequential write of 578.3MBps.

You'll notice that there's some variation in the numbers, though each set of results are impressive. Promise says that queue depth, which is the number of read and write requests waiting to access the drive, has a big impact on the performance levels. The File System Bandwidth test runs at a queue depth of eight, and we set the ATTO Disk Benchmark to a queue depth of 10. According to Promise, higher queue depths will perform better than lower queue depths up to a point, with an optimal queue depth of 16. CrystalDiskMark numbers are a bit lower because the benchmark runs tests at a queue depth of 32. Promise indicates that video creation and audio applications would have a queue depth around eight, so the speedy File System Benchmark and ATTO Disk Benchmark numbers are close to what you'd see in real-world editing applications. Bottom line, the sequential speeds display how fast the Thunderbolt 2 can operate when put to task.

We also ran PCMark8's Storage tests that use workload traces to provide some other examples of real-world performance. For instance, the storage trace in Battlefield 3 is recorded while a user opens the program, logs in, loads a saved game, and starts playing. Numbers are listed in seconds, because the test measures how long it takes the drive to complete the task. The Battlefield 3 trace took 232.9 seconds, while World of Warcraft took 93.8 seconds. Traces are also run on Microsoft Office apps. The Thunderbolt 2 connection helped to run the trace in 37.7 seconds in Microsoft Word, 16.6 seconds in Microsoft Excel, and 16.2 seconds in Microsoft PowerPoint.



The Promise Pegasus2 R8 (www.promise.com/pegasus2) delivers maximum available Thunderbolt 2 speed with huge capacity and enterprise-class RAID protection.

ASUS Achievements

With the Z87-PRO and ThunderboltEX II, you'll have everything you need to add Thunderbolt 2 compatibility to your rig. The speedy transfer capabilities alone make the upgrade worthwhile, but we also like the support for 4K monitor connectivity via DisplayPort, because it gives us another high-quality video output option. Those with multiple Thunderbolt-enabled PCs can even share high-performance peripherals among systems (like our massive, incredibly fast Pegasus RAID box, for example). If you're ready for faster storage and better display connectivity options, ASUS has what you're looking for. ■

ASUS THUNDERBOLTEX II/PROMISE PEGASUS2 R8

CrystalDiskMark 3.0.1 (MBps)	
Sequential Read	731.5
Sequential Write	578.3
512KB Random Read	68.3
512KB Random Write	97.65
SiSoftware Sandra 2014 SP1 Lite	
Physical Disks (Queue Depth 8)	
Read (MBps)	823.36
File System Bandwidth (Queue Depth 8)	
Read Bandwidth (MBps)	682.21
Write Bandwidth (MBps)	1000
File System I/O	
Device Score (kIOPS)	6.7
ATTO Disk Benchmark (256MB Length, Queue Depth 10)	
Maximum Read Speed (MBps)	1366
Maximum Write Speed (MBps)	860
PCMark 8 (Storage Test)	
Storage Score	3128
Storage Bandwidth (MBps)	16.71
World of Warcraft (seconds)	93.8
Battlefield 3 (seconds)	232.9
Adobe Photoshop light (seconds)	154.4
Adobe Photoshop heavy (seconds)	405.8
Adobe InDesign (seconds)	109.7
Adobe After Effects (seconds)	115.8
Adobe Illustrator (seconds)	129.6
Microsoft Word (seconds)	37.7
Microsoft Excel (seconds)	16.6
Microsoft PowerPoint (seconds)	16.2

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GIGABYTE BRIX Gaming

Handheld Gaming, Reinvented

The miniature BRIX Gaming gives you the performance you've come to expect from a larger rig.

Here at CPU, we love LAN parties. Truth be told, there's really not much we'd rather be doing than gaming all day (and night), surrounded by friends and fellow gamers. But there's one thing about LAN parties we don't like—lugging our rigs to the venue. This process sometimes means boxing up our systems and adding extra protection to ensure that the graphics card(s) and other heavy components can safely travel in the car. Even microATX and Mini-ITX systems can be bulky and tough to carry long distances.

Enter GIGABYTE's BRIX Gaming ultra-compact PC kit (model GB-BXA8G-8890). This Lilliputian system measures a mere 2.32 x 5 x 4.5 inches (HxWxD), and GIGABYTE includes a VESA bracket so you can mount it behind your monitor or HDTV. Imagine needing a single trip to carry in both your gaming PC and monitor into a LAN party.

"We were inspired by Intel's Next Unit of Computing design and wanted to expand on the computing experience with this small and powerful PC," says Leon Chen, PR manager at GIGABYTE, "not only to the living room as an entertainment system but also as a powerful gaming system."

For the right person, GIGABYTE's BRIX Gaming is perfect fit as a LAN PC or HTPC. For such a small system, it's packed with cutting-edge tech that begs for a closer look.

Gaming Performance

GIGABYTE knows that gamers don't want to abandon desktop PC

The front panel offers two USB 3.0 ports and a headphone jack.

On the rear panel, you'll find HDMI and mini DisplayPort video outputs, two USB 3.0 ports, a Gigabit Ethernet port, and a Kensington lock slot.

performance just for the sake of portability. As a result, GIGABYTE wanted hardware that could produce massive graphics horsepower within the confines of a pint-sized enclosure. "We chose components that provided high performance and maximum gaming experience," says Chen. "Gamers should definitely be excited about the graphics portion of the BRIX Gaming."

Inside the BRIX Gaming, you'll find a Radeon R9 M275X discrete GPU that offers 2GB of GDDR5 memory. The R9 M275X supports DirectX 11.1, Shader Model 5.0, and OpenGL 4.1, so you'll be able to play today's newest titles at moderate resolutions and quality setttings.

The BRIX Gaming is built with more than just a high-performance GPU. GIGABYTE includes an AMD A8-5557M APU, a Richland-based APU that provides you with four cores that run at a 2.1GHz base clock. When under certain loads, the A8-5557M uses AMD's Turbo Core technology to boost the clock speed up to 3.1GHz. AMD also loads up the A8-5557M with 4MB of L2 cache. The chip has a low TDP of 35 watts, which is great because there's no need for a large cooling system to remove hot air during long gaming sessions.

On the subject of what resolutions and settings gamers could use with the BRIX Gaming, Chen says, "On average, gamers shouldn't have any problems playing their favorite game in 1080p. The graphics card that is included in the unit is a powerhouse that can deliver them the most up-to-date graphics performance." We love the idea that a system small enough to fit in the palm of your hand can provide HD gameplay.

Multimedia Capabilities

Enthusiasts who also want a portable rig for video editing, for example, will like that the discrete GPU supports the OpenCL 1.1 standard. Applications that utilize OpenCL acceleration can enlist the BRIX Gaming's Radeon R9 M275X to help with media-editing and encoding applications. "The BRIX Gaming system is perfect for everyday computing tasks," says Chen. "With the . . . dedicated graphics card, it makes video editing, streaming, and spreadsheets a breeze."

GIGABYTE designed the BRIX Gaming with HDMI and mini DisplayPort outputs, so you'll be able to connect it to an HDTV or monitor. You can even use both video outputs at the same time for a dual-display setup that spans the Windows Desktop across both screens. The BRIX Gaming supports a maximum resolution of 1,920 x 1,080 (at 60Hz) via the HDMI output, while the mini DisplayPort can produce a maximum resolution of 4,096 x 2,160 (at 30Hz).

"This system is a great companion for anyone's TV," adds Chen. Realtek's ALC269 codec supplies the BRIX Gaming's sound capabilities, and you'll be able to deliver those sounds over the HDMI and mini DisplayPort outputs, as well as a headphone jack.

Connectivity

The BRIX Gaming is no slouch when it comes to wired and wireless connectivity. GIGABYTE has smartly added a mini PCI-E wireless module to the PC (located below the BRIX Gaming's mSATA connector), giving it wireless connectivity for both Bluetooth 4.0 and 802.11a/b/g/n/ac. "We opted for these wireless connections as Bluetooth is becoming more widely used in mobile devices," says Chen. "We chose to include Wi-Fi as not everyone's home theater system has wired [network] connectivity."

For wired connectivity, the front panel offers a headphone output and two USB 3.0 ports, while the rear panel offers two more USB 3.0 ports, an Ethernet port, and the HDMI and mini DisplayPort video outputs. Those concerned about the security of the miniature gaming system will like that GIGABYTE includes a Kensington lock slot.

What You'll Need To Add

The BRIX Gaming is a barebones system that gives you the flexibility to select your own SO-DIMM memory, system storage, and operating system. "We know that consumers use systems differently and they all have different preferences," says Chen. "We sell it barebone to allow consumers to be able to customize and upgrade."

For memory, the BRIX Gaming provides you with two SO-DIMM slots that together can handle up to 16GB of DDR3L (1.35V) clocked at 1,333MHz or 1,600MHz. The low-voltage memory should produce less

EASY INSTALLATION

GIGABYTE Brix Gaming Setup

Once you've selected the SO-DIMMs and storage drives you want to install in the BRIX Gaming, it'll only take a few minutes to get everything installed. Just remove the four screws in the bottom panel and lift away the base. From there, you'll be able to access the SO-DIMM slots and mSATA SSD slot on the motherboard. If you opt for a 2.5-inch drive, you'll need to unscrew the four screws holding the HDD cage in place. Then, you can secure an SSD or 2.5-inch HDD to the cage and screw it in place on the bottom panel. Finally, you can attach the SATA power and data cables and reinstall the bottom panel. In all likelihood, the operating system will take longer to install than these components.

As a barebones system, the BRIX Gaming lets you pick the amount of memory and storage inside the system.

> We know that consumers use systems differently and they all have different preferences. We sell it barebone to allow consumers to be able to customize and upgrade. -Leon Chen, GIGABYTE PR Manager

GIGABYTE BRIX SPECS

Processor	AMD A8-5557M (2.1GHz/3.1GHz)
Chipset	AMD Bolton M3
Graphics	AMD Radeon R9 M275X
Max memory	16GB DDR3L (1,600MHz)
Expansion slots	1 mSATA, 1 6Gbps SATA, 1 half-size mini PCI-E (occupied by 802.11a/b/g/n/ac + Bluetooth 4.0 module)
Front I/O	2 USB 3.0, 1 headphone jack
Rear I/O	1 HDMI, 1 mini DisplayPort, 2 USB 3.0, 1 Gigabit Ethernet, 1 DC-in, 1 Kensington lock slot

heat than 1.5V DDR3 SO-DIMMs, which is helpful considering the BRIX Gaming's tiny enclosure.

For storage, you can use a 2.5-inch drive, as well as an mSATA SSD. These storage options give you some freedom to customize the BRIX Gaming according to your performance and capacity needs. For instance, HTPC builders can install an mSATA SSD as a boot drive and use a large 2.5-inch hard drive to provide the necessary capacity for HD videos and large music collections. Gamers, on the other hand, may opt for a single 2.5-inch SSD that has enough storage for their favorite titles. Whatever your preference, it's nice that you can make choices for the memory and storage that fit your budget, rather than being forced to use a preset configuration.

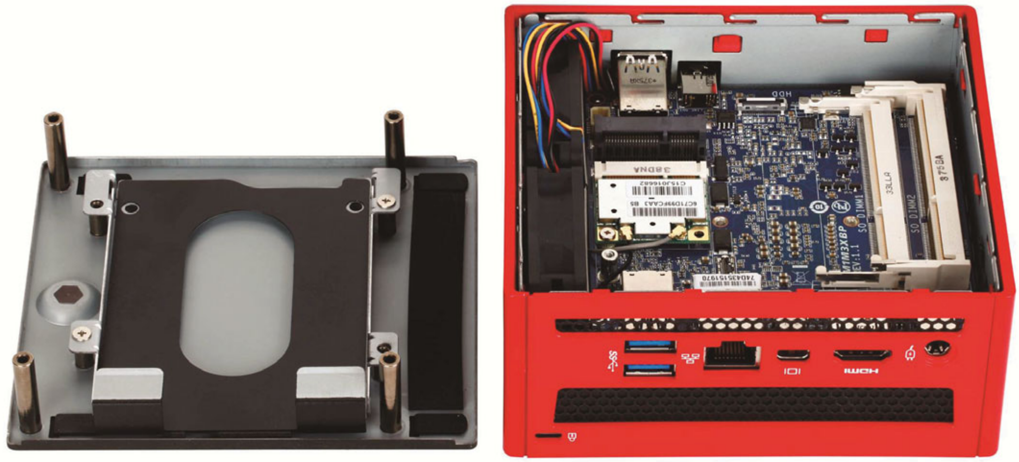
A VESA mounting bracket is included to let you mount the system to the back of an HDTV or monitor.

Power Options

GIGABYTE locates the power button on top of the unit, but you're also able to configure the BRIX Gaming to turn on through a connected USB keyboard or mouse. (This feature was only available to Windows 8 systems at the time of this writing.) This is ideal if you've placed the BRIX Gaming behind an HDTV or monitor, where it would be inconvenient to reach every time you want to turn it on. To set up the USB power, just press F2 or DEL during startup to enter the BIOS. Then, choose Chipset, select the ErP option, and choose Disabled. Save and exit the BIOS. Then, install the USB Power-On Patch for Windows 8, which you can find in a folder of the same name on the BRIX Gaming's driver CD. Your system can now power on at the press of a key.

BRIX Strength

We can't imagine a full-fledged gaming PC that's smaller than the BRIX Gaming, and it's more than just a gamer. It can also function as a capable HTPC. We particularly like the ability to mount the system to the back of any HDTV with a VESA mount, as you won't even need an entertainment center or audio cabinet to conceal it, plus its extensive wireless networking support lets you install it virtually anywhere without worrying about the need to make a cable connection. Now, we just need some sort of collapsible monitor so we can fit an entire gaming rig in a backpack. ■



You can install a 2.5-inch drive into the BRIX Gaming.

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Install SteamOS

We've been following Valve's first foray into the operating system business via its Steam Machine initiative with interest. Chances are good that you have been, too, whether you're a staunch card-carrying member of the PC Master Race or just a fan of games regardless of the platform on which they're played. We first covered Steam Machines in our December 2013 issue, and at the time, we described Steam Machines as Valve's attempt to bring your Steam game library into your living room, where your best sound system, largest display, and comfiest chair live. If Valve is trying to pry itself into your entertainment center beside, or in place of, your gaming console, then SteamOS is its crowbar.

Sorry Windows, You're Not Invited To This Shindig

Until now, gaming systems running Steam as a discrete application were largely Windows-based systems. It's true, Steam runs on Mac OS and Linux, but according to the Steam Hardware & Software Survey: February 2014, those operating systems accounted for just 3.42% and 1.3% of Steam's users, respectively. With SteamOS, Valve has created a Linux-based operating system designed solely for gaming and entertainment. For those with a tendency to tinker, Valve has released a beta version of SteamOS, ready to download and install on the system of your choice. In this article, we'll walk you through the fairly painless process of building your own beta Steam Machine, show you what it looks like, and perform some cursory benchmarking to see what kind of performance you can expect to get from the platform.

Hardware Checklist

The current minimum system requirements for running SteamOS are about as restrictive as those for running most forms of Linux. Hardware manufacturers tend to prioritize driver software development for Windows platforms, and often the community of Linux developers and users is left to pick up the slack. SteamOS is based on Debian 7 (aka "Debian Wheezy"), a popular and highly-stable Linux distribution.

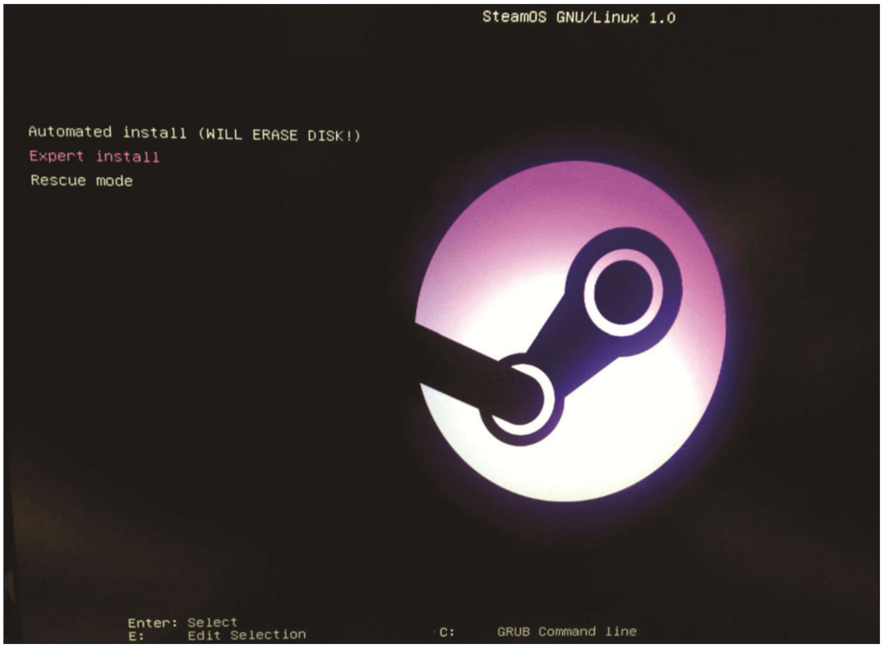
According to Valve, you can install SteamOS on a system with a 64-bit AMD or Intel processor, 4GB or more RAM, a 500GB or larger storage drive, an NVIDIA graphics card, and a motherboard that supports UEFI booting and at least one USB port. The USB drive you'll use to install the OS needs to have a capacity of at least 4GB. The firm mentions that support for AMD- and Intel-based GPUs is coming, but as we go to press, the beta does not support them. Also keep in mind that Steam OS will slice up your hard drive or SSD into a handful of partitions after completely wiping it; so forget about dual-booting SteamOS for now. If you decide to try it out, choose a clean drive that you're fine letting SteamOS format.

For our test system, we used an Intel Core i7-4960X processor, a GIGABYTE GA-X79-UP4 motherboard, a GeForce GTX 780 from GIGABYTE (the GV-N780GHZ-3GD), 16GB Patriot Viper Xtreme DDR3-1866, and a 600GB Western Digital VelociRaptor. To serve as our installation media, we used a 4GB USB 2.0 thumb drive. We also used a Windows-based system to prepare the USB drive and download the SteamOS installation files.

Installation Process

To begin, we used our Windows system to format our thumb drive as a FAT32 storage device; do this by right-clicking the device in Windows Explorer, clicking Format, leaving the Capacity and File Setting options at their defaults, and making sure the Quick Format checkbox is marked to save you some time. We also changed the Volume Label to SteamOS and then clicked Start. Click OK to dismiss the operation complete pop-up.

Our next step involves visiting the SteamOS Beta download page and selecting an installation method. Visit store.steampowered.com/steamos/buildyourown



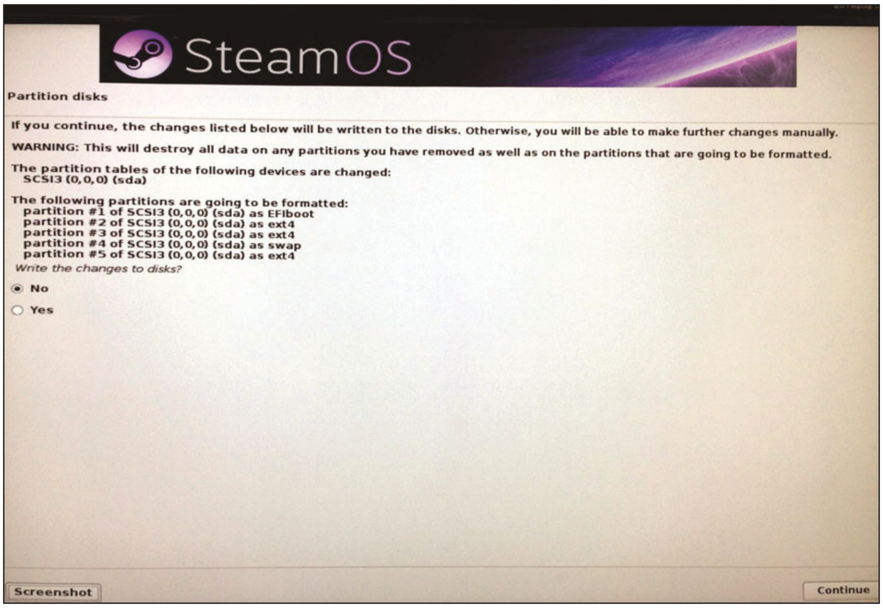
Keep in mind that when you install SteamOS, it'll wipe your hard drive.

and select either the Default or Custom Installation. At first we tried the Default Installation, but our system wouldn't boot from the thumb drive with those files extracted onto it. The Custom Installation, on the other hand, is still a very simple process despite including a handful more steps.

To begin, we clicked the Download The Custom SteamOS Beta Installation, clicked the Agree checkbox on the Steam EULA on the following screen (after reading it thoroughly, natch), then clicked the Download SteamOS Beta button. You can also access the SteamOSInstaller.zip file manually by visiting repo.steampowered.com/download. The file was 966MB as we went to press, which took a while to download. When the download was complete, we launched the zip file with WinRAR by double-clicking it, clicked Extract To, navigated to our USB drive via the Destination Path field, and then clicked OK. When the process (which was also somewhat lengthy) completed, our USB drive was ready to go.

Next, we shut down our test system, removed the SSD we were running Windows on, plugged in the Western Digital VelociRaptor, and plugged the USB drive into a vacant USB port. We restarted the system and pressed DELETE to access the BIOS. (The key that grants you access to the BIOS on your system may vary; common keys include DELETE, F1, F8, and F12.) From here, we set the system to boot from the UEFI USB drive, saved the changes and exited, and rebooted. Shortly thereafter, we saw a large purple and white Steam logo with a few installation options. Next, we highlighted Automated Install and pressed ENTER to proceed. Note that if you use the Expert Install option, you'll have the opportunity to choose a language (other than English), change your location (to something other than United States), alter the keyboard layout (to something other than American English), and tweak the default partitions, which consist primarily of two 10.4GB EXT4 partitions, a 10.4GB swap partition, a 500MB EFI boot partition, and a fifth EXT4 partition that accounts for the rest of the drive's capacity. This lattermost partition is where the SteamOS, your applications, and games will reside.

When the installation was finished, the Steam Install Agreement window appeared; we clicked the I Have Read And Accept These Terms checkbox, then clicked OK to install the Steam application. But before logging in, we needed to grant ourselves root access by logging in using the desktop account. We launched the Terminal by clicking



If you continue, the changes listed below will be written to the disks. Otherwise, you will be able to make further changes manually.

WARNING: This will destroy all data on any partitions you have removed as well as on the partitions that are going to be formatted.

The partition tables of the following devices are changed:
SCSI3 (0,0,0) (sda)

The following partitions are going to be formatted:
partition #1 of SCSI3 (0,0,0) (sda) as EFIboot
partition #2 of SCSI3 (0,0,0) (sda) as ext4
partition #3 of SCSI3 (0,0,0) (sda) as ext4
partition #4 of SCSI3 (0,0,0) (sda) as swap
partition #5 of SCSI3 (0,0,0) (sda) as ext4

Write the changes to disks?

● No

○ Yes

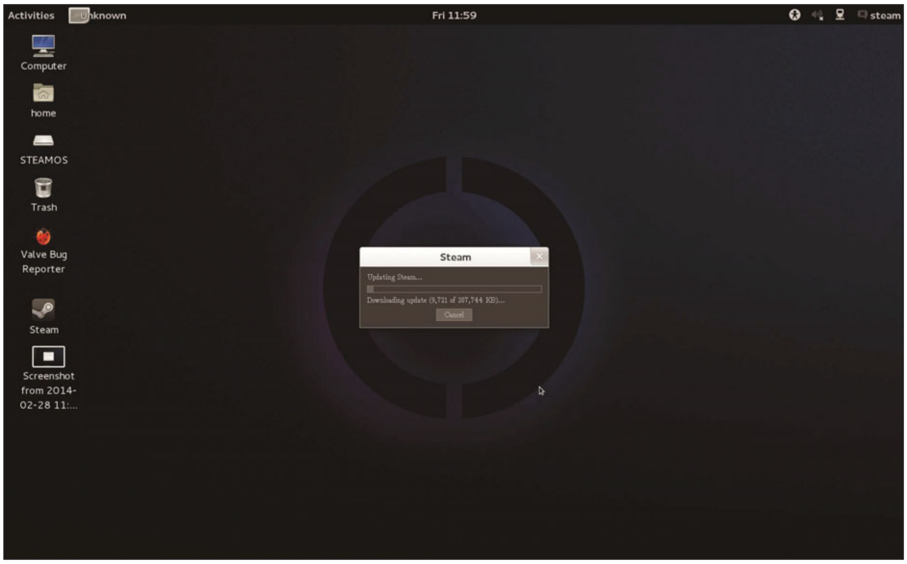
SteamOS automatically partitions your storage drive for you.

Activities in the upper-left corner of the screen, selecting Applications, then clicking Terminal. Then we typed **passwd** at the prompt, and then pressed ENTER. Next, we input a new password twice to confirm it, which enabled us to perform superuser tasks using the sudo command.

When Steam was finished updating, we logged into Steam as usual using our Steam username and password. If you are prompted to log in as a user (for SteamOS, not the Steam application), use "steam" as the default account login, or to log in to the desktop account using the password you just set.

If you're running Steam's 10-foot UI/Big-Picture-Mode look-alike, you can simply click the power/Exit icon, and click Restart to reboot. If you're in the Debian desktop environment, however, you'll need to click Activities in the upper-left corner of the screen, then click Steam in the resulting list. From here, you can just click that Exit icon in the upper right and click Restart.

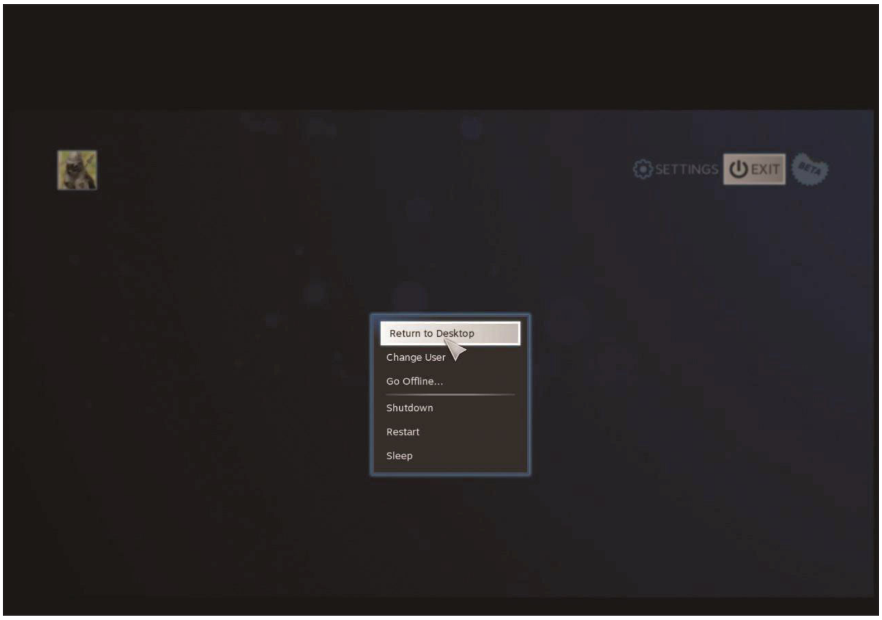
Just let the system restart (don't select the Recovery Mode option when prompted). The version we installed, SteamOS Update 89, automatically created a recovery partition upon reboot, so just follow the prompts to perform this task. The beta is constantly being updated, so the installation process may differ for you in some small ways. The version we installed performed a few functions that deviated from Valve's own published steps. Even so, we recommend following Valve's installation instructions for the latest build (on the page that includes the link for the installation files) instead of relying solely on our tutorial for the whole process.



Updating Steam...

Downloading update (9,721 of 207,744 KB)...

Once you reach the Debian desktop environment, Steam will begin updating immediately.



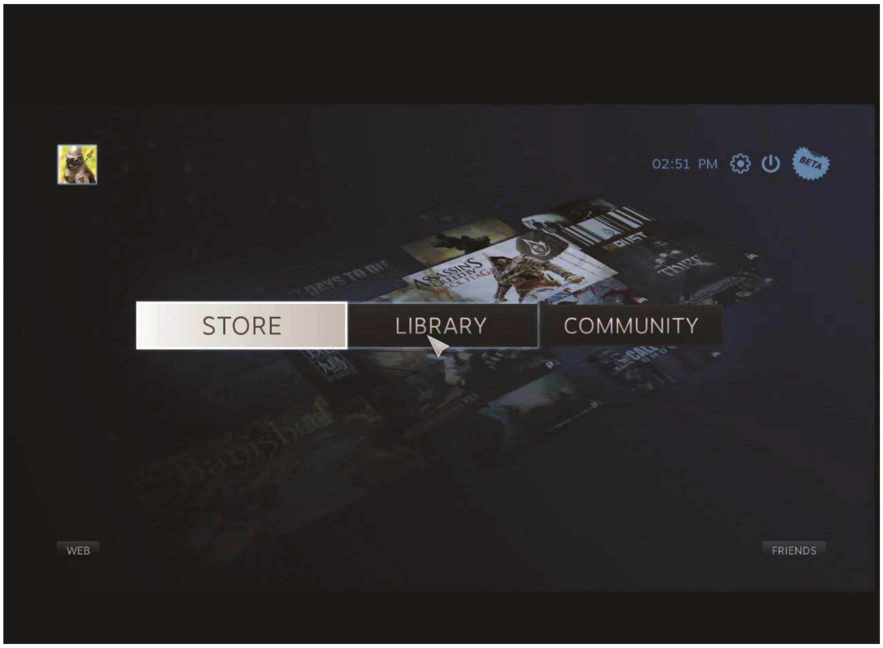
From within the SteamOS UI, you can click the Exit icon to return to the Debian desktop, restart, shutdown, or initiate sleep mode.

When the system finally restarts, you should be prompted to log into Steam. If you see the familiar Steam login prompt, enter your username and password for that account. From here on, you can enjoy SteamOS as it was meant to be. By default, the system should also boot directly to the SteamOS UI. If not, you can always access it by clicking Activities, Applications, and Steam.

SteamOS Interface

Before we dive into the particulars of the SteamOS UI, you can make it easy to back out to the Debian desktop environment from the SteamOS UI by clicking Settings in the upper-right corner of the screen, clicking Interface, placing a check mark in the Enable Access To The Linux Desktop checkbox, and then clicking Done. Now, when you click the Exit icon from the Steam IU, you'll have a Return To Desktop option in addition to the Shutdown and Restart commands.

The main start screen for SteamOS has three buttons, Store, Library, and

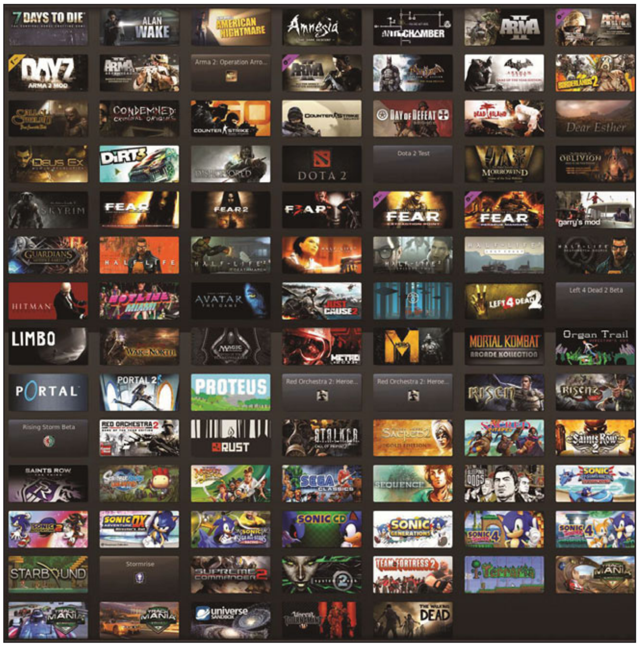


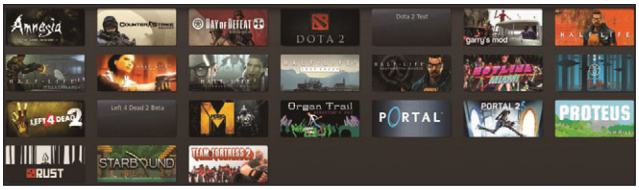
The Store is where you buy games, the Library is where you launch games, and the Community is where you meet with friends and other gamers.

Community, which correspond to the same options you'll find if you launch Big Picture Mode in the Windows-based Steam application. In fact, you'll have a hard time distinguishing Big Picture Mode from SteamOS' Steam UI. Click the Store button and you'll see a scrollable list of a dozen or so featured games and large icons below that for Specials, the Weekend Deal, free-to-play specials, and the Daily Deal. Buttons along the bottom edge of the screen let you access the Web, Search, and manage your Friends list. In any submenu, you can always jump back to the main menu by clicking the circular silver Steam logo in the upper-right corner of the screen.

You'll find your Steam games in the Library submenu, in a similar scrollable list, but these are your most recently played games. You can click View All Games to switch to a tile-based view. By default, this shows all the games you own, but not all of them will work in SteamOS. Click the drop-down menu at the top of your library to access a handful of sorting options; you can view All Games, Recent, Installed, Favorites, Controller Supported, and SteamOS. The latter-most option will display the games in your library that run in SteamOS (Linux). Of the 94 games in our Steam Library, just 22 worked in SteamOS. Click any of the games and you'll get another scrollable list of actions, including Links & More, Install (if the game is supported in SteamOS), Play (if it has been installed), Recent News, Guides, Achievements, Friends Who Play, Workshop (if supported), and more. If the game isn't supported in SteamOS, you'll just see a Not Available tile in place of the Install/Play tile. When you click Play, the game launches and plays just as you'd expect it to.

We did notice that in the translation from DirectX to OpenGL, the video settings menus of various games differed. For instance, in Metro: Last Light running on Windows, we can set the resolution and quality, enable or disable SSAA (Super-Sampling Anti-Aliasing), adjust texture filtering, set the amount of motion blur, enable and disable tessellation, and turn Vsync on or off. When running on SteamOS, Metro: Last Light's video options are reduced to a simple Quality





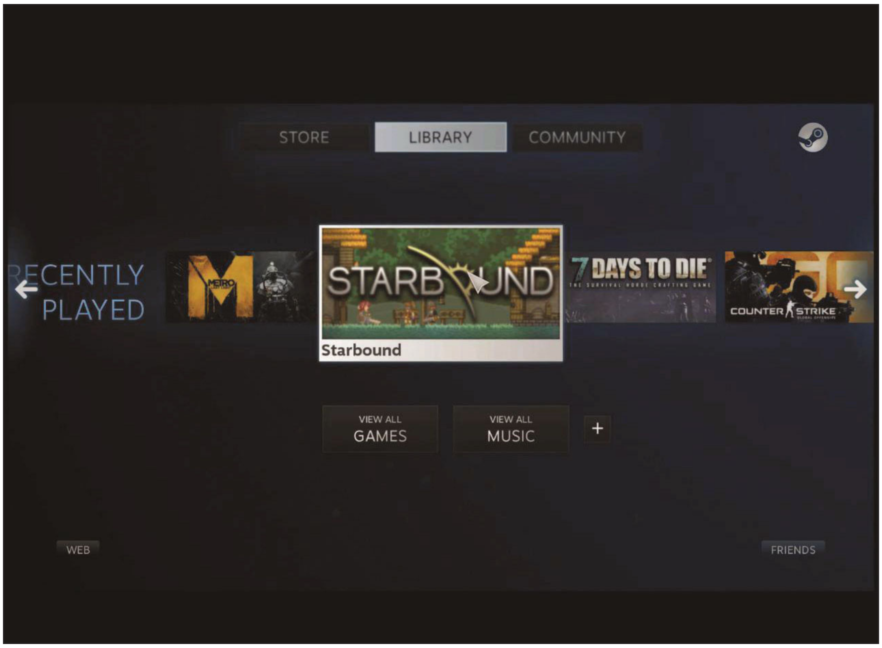
On the left is a list of the Steam games in our library that work in Windows . . . on the right is what that list looked like when we viewed just the games supported in SteamOS.

slider. In Windows, poor performance can be easily solved by disabling the particularly system-crushing SSAA (supersampling antialiasing) setting and reducing tessellation. If you need to tweak the performance in this game on SteamOS, your only option is to move the Quality slider to the left. For hardcore gamers, this is less than ideal. It also makes it nearly impossible to make apples-to-apples performance comparisons between the Windows and SteamOS versions of a game. But we'll explore performance discrepancies a little later.

Back in the Library, you can click any of the game icons, yet easily access your Friends list and a web browser using the appropriate buttons in the lower-right and -left corners of the screen. When you click Friends, you'll see your list on the left side of the screen and a chat window on the right. Click the Groups tab to view the groups you're a member of along the left side of the screen. Click any of them, then click Join Chat at the bottom of the screen to participate in a group text chat session. From here, you can also click buttons to enable voice chat or leave the chat.

Click the silver Steam logo in the upper-right corner to go back to the main menu and click Community to see your friends in a scrollable list of thumbnails. Roll the mouse wheel to cycle through them and determine their online or offline status. Below your Friends list you'll find the Activity Feed, which displays recent items, such as achievements you and your friends have earned, games you've added to your wish list, any news posts from the groups to which you've subscribed, and more.

If you click the silver Steam icon again to return to the main hub and point to the icons in the upper-right corner of the screen, you'll see an Exit button and a Settings button. Click on the latter to see Account, Friends, In-Game, In-Home Streaming, Language, Interface, Family View, Controller, Display, Audio, Music, Voice, Downloads, Network, System, Time Zone, and Remote Control settings. Many of these are fairly self-explanatory, but there are a few items we'd like to draw your attention to. The In-Game settings menu shows you how to display the Steam Overlay as it appears when playing a game (SHIFT-TAB, Xbox 360 controller's Guide button) and configure the screenshot hotkey, and lets you choose whether to display notifications and play sounds. The In-Home Streaming menu lets you set bandwidth, resolution, and frame rate limits. The Controller settings will report No Controller Detected if you don't have a controller plugged in. When you do plug in a controller, it'll let you click Edit Controls to define global settings for common commands. You may also want to check the Audio setting if your DIY Steam Machine is delivering audio through a device other than the HDMI interface on your graphics adapter. Click System to check for system updates and to make sure SteamOS recognizes your hardware.

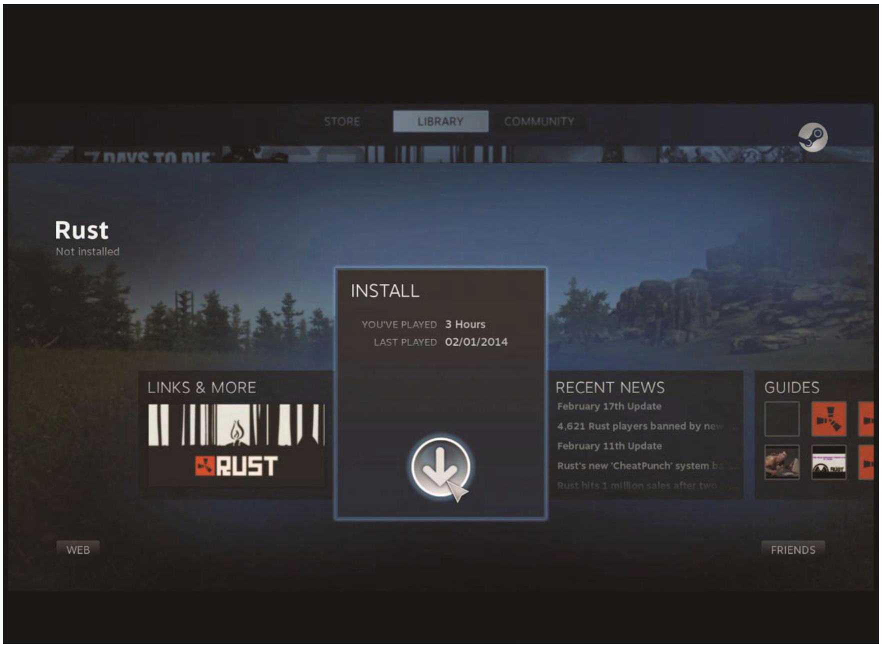


Quite a few new and still-under-development games will work in SteamOS.

The only other aspect of SteamOS we've not already covered is the music library integration. From the Library menu, click Music to modify the directories SteamOS checks for music; the Home/Steam/Music and Home/Steam/.Local/Share/Steam/Music directories are both set by default. According to Valve, plans for SteamOS to include streaming music and video services are in the works.

Benchmarks

One of the reasons Valve (and others) cite when attempting to make a case for ditching Windows for Linux is the performance gains that you can achieve when running an operating system with significantly less overhead. A couple years ago, when Valve was just beginning to explore Linux's potential to be a gaming platform, the team behind the initiative spent a handful of weeks porting Left 4 Dead 2 to Linux, and was eventually able to illustrate a 16% performance advantage with a fully optimized version running on Linux. However, in optimizing the game for Linux and working with AMD and NVIDIA driver software developers, Valve also made improvements to the Windows version, which increased frame rates from 270fps on their test platform to 303fps. With these improvements,



YOU'VE PLAYED 3 Hours
LAST PLAYED 02/01/2014

February 17th Update
4,621 Rust players banned by new …
February 11th Update
Rust's new 'CheatPunch' system b…
Rust hits 1 million sales after two …

If the game is supported, you'll have the opportunity to install it after clicking in the game's tile.

Linux's advantage shrank to just less than 4%. We're always going to be a fan of faster frame rendering, but you'd be hard-pressed to notice the difference between such high frame rates.

As we mentioned earlier, comparing Metro: Last Light with identical settings would be impossible without knowing exactly what the Quality slider in the SteamOS version of the game actually adjusts. Frankly, we've seen better video settings in recent console games.

The closest apples-to-apples comparison we could find was to run the effectively ancient Half-Life 2: Lost Coast video stress test. With a 1,920 x 1,200 resolution, we set the Model Detail, Shadow Detail, and Shader Detail to High. We set Texture Detail to Very High, Water Detail to Reflect All, enabled color correction, disabled Vsync, enabled Motion Blur, enabled Multicore Rendering, set Antialiasing Mode to 8X MSAA, set Filtering Mode to Anisotropic 16X, and set the High Dynamic Range to Full. The only hardware discrepancy between the two systems was the hard drive; as previously mentioned, the SteamOS system was running a 600GB Western Digital VelociRaptor. The Windows 8 Enterprise OS ran on a 1TB Western Digital Black hard drive. In SteamOS, we scored 290.61fps. In Windows, our score was 294.3. That's slightly more than a 1% difference, which, again, is not something you'd ever be likely to notice.

Killer OS?

Here at CPU, we have systems running various versions of Windows, Linux, and Mac OS. Regarding the software foundation of our gaming systems, however, Windows has had a distinct advantage over the rest, largely thanks to Valve's Steam platform. With SteamOS, Valve has given Linux gaming the shot in the arm it needed to be taken seriously. But the real question is, can Linux do it better than Windows?

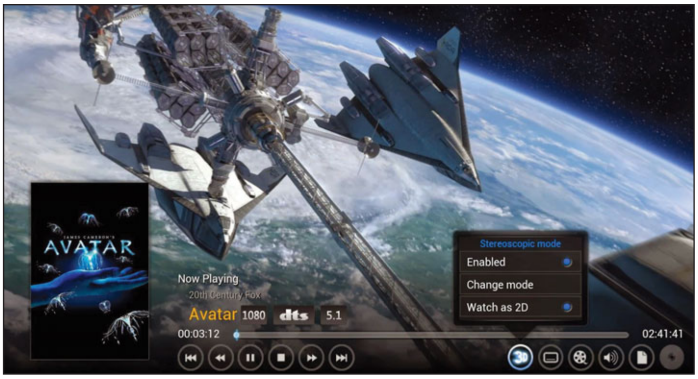
When it comes to raw performance, the answer is murky. The example we cited above regarding Metro: Last Light is not so much an obvious failure on the part of Valve/SteamOS/OpenGL as it is an indictment of how the developer of the game chose to deal with its SteamOS port. Based on our own observations, it's clear that judging raw performance between Windows and Linux is more complicated than simply comparing frames-per-second scores. Other factors to consider include the quality of the graphics drivers, the code optimizations that the game developers are most responsible for, and the other code that defines how Windows and Linux access and use the hardware that comprises your system. In our estimation, some games that rely on the OpenGL API perform better with comparable visual effects, and in other games, DirectX delivers the more compelling experience. Don't forget, however, that Microsoft too has a stake in which API developers favor, and the firm won't just roll over in the face of OpenGL's advances.

You also can't forget the user experience. One of the things traditional consoles have had going for them is their simplicity: To play a console game for the first time, just pop in the disc or launch the digital game from the console's game library and within seconds you're gaming. (Yes, we realize that modern consoles have begun to enforce mandatory installs and regular updates.) With a Windows PC, you have to grapple with all the typical driver maintenance, navigate the occasional workarounds, and contend with a UI that was never designed to be viewed on a TV from 10 feet away. SteamOS may be working toward a more hassle-free, console-like experience, but that's not the case today with the beta. In fact, as a platform, SteamOS currently offers very little that Windows and consoles do not already offer.

The good news is, all of the above can and will improve as time goes on. The bad news is, trying to make a determination based on a beta version of Valve's operating system is practically impossible, if not simply unfair. So for now, SteamOS has the distinction of being the reason we don't laugh when the words "Linux" and "gaming" are used in the same sentence. Bravo, Valve, you have our attention. The benefits for the Linux crowd are manifold. But now it's time to give gamers who just care about games a reason to get excited. ■

Inside The World Of Betas

XBMC 13.0

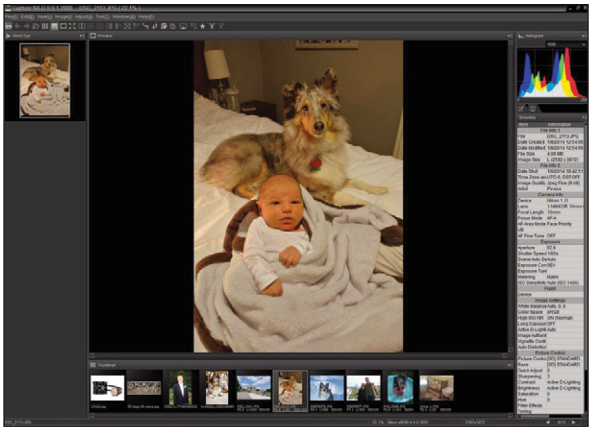


XBMC 13.0
Publisher and URL: XBMC; xbmc.org
ETA: Unknown
Why You Should Care: It comes with hardware decoding for select Android devices and offers speed improvements on low-power platforms, such as Android and Raspberry Pi.

This open-source media player is a popular alternative to Windows Media Center, and it's known for being highly customizable through the use of skins and add-ons for online services. XBMC offers versions of the XBMC 13 beta for Windows, OSX, Android, Apple TV, iOS, and Linux. One of the key features in the XBMC 13 beta is support for hardware decoding in Android (running Android 4.0 or later). Previously, video processing was done through software decoding that could severely tax a mobile device's processor and may prevent you from watching HD video. With hardware decoding, XMBC 13 can use the graphics processor in your mobile device to improve playback.

XBMC 13 also adds support for stereoscopic 3D rendering for the SBS, TAB, and anaglyph formats. The interlaced 3D format is also available on supported platforms for passive TVs. XMBC notes that the 13 beta doesn't yet support 3D Blu-rays, nor cannot it provide hardware acceleration for Full SBS/TAB formats. The latter means that 3D playback will require a high-power CPU. To improve connectivity between devices, the XBMC 13 beta offers new UPnP capabilities where separate instances of XBMC can work together. For instance, XBMC points out that you could browse an UPnP library on your tablet and send the video to the XBMC 13 program on your HTPC. There are a number of other handy new features, as well. ■

NIKON CAPTURE NX-D



Nikon Capture NX-D
Publisher and URL: Nikon; beta.nikonimglib.com
ETA: Unknown
Why You Should Care: This free software lets you process and adjust RAW images from Nikon digital cameras.

The Capture NX-D beta has been developed by Nikon to meet user demand for an application that can handle more advanced RAW image controls. Even better, Nikon plans on making Capture NX-D available free of charge on its website when the beta testing period is finished. With Capture NX-D, you'll be able to adjust white balance and exposure—as well as compensate for lens correction and noise reduction—in RAW images captured by Nikon digital cameras. It also supports Nikon's Picture Control System for specifying imaging characteristics. Capture NX-D works with more than just RAW images, as it also supports .JPEG and .TIFF formats. Available editing features aren't as comprehensive with the .JPEG and .TIFF formats, but you'll still be able to do things like crop and make adjustments to brightness, contrast, and tone curves.

We like that Nikon provides support for multiple monitors. Capture NX-D lets you expand the display area by moving floating palettes among monitors. You can even stitch together two or more floating palettes, so that the palettes can move together to a different monitor. When you save RAW image files, Capture NX-D uses a sidecar format that preserves the RAW file by saving adjustments to a separate, non-destructive file. Nikon indicates that the sidecar format also makes it easy to simultaneously apply adjustments to multiple files in batches. It's also easy to transfer RAW images to other applications as 16-bit .TIFF files for viewing. ■

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Upgrades That'll Keep You Humming Along

This month, we take a look at the first service pack for Office 2013 and a key update for the Evernote desktop application. We also found an NVIDIA driver update for Linux users, as well as an Intel driver update that adds Quick Sync Video capability to select processors.

SOFTWARE UPDATES

Evernote 5.2.0.2946

Evernote has announced two improvements for its Windows desktop utility. The first is an Annotation Tool that lets you add callouts to images saved in your Evernote account. You can use arrows or stamps to point things out within images, such as points of interest on a screenshot of a map. You can also add text and shapes to your notes. The second improvement comes in the area of sync performance; Evernote indicates that people with sizable accounts will notice a major improvement in sync speed following the update.

evernote.com/evernote

Microsoft Office 2013 SP1

SP1 for Microsoft Office 2013 offers compatibility improvements for both software and hardware, including Windows 8.1, Internet Explorer 11, high-DPI devices, and precision touchpads. With SP1, Microsoft also adds support for new apps and APIs for third-party developers. For instance, Outlook 2013 SP1 offers support for task pane apps that allow third-party developers to extend the compose experience for email messages and calendar items. With PowerPoint 2013 SP1, you'll now have the ability to insert and use content apps in PowerPoint 2013 slides. To improve stability, Microsoft identified COM add-ins that were reported to crash in large volume, and SP1 will block these add-ins from starting. You can manually re-enable the add-ons if you need them to run.

www.microsoft.com/en-us/download/details.aspx?id=42006

NTWind Software WinSnap 4.5

WinSnap is a screen capture utility that's capable of enhancing screenshots with shadows, reflections, outlines, watermarks, and color effects. With the 4.5 update, NTWind Software has redesigned the interface to allow for easier access to program options and tools. For instance, you can now switch between native and custom shadow effects directly after capture. WinSnap can also automatically remove the native Aero shadow and replace it with a custom shadow effect. There's also a new Pen tool for drawing a smooth spline curve.

www.ntwind.com

Skype For Modern Windows 2.6

Skype for modern Windows 2.6 runs on devices with Windows 8.1, and the update focuses on cross-device synching. You can take Skype calls from your mobile device, your Outlook.com inbox, your desktop PC, or your tablet, and wherever you pick up your call, incoming rings across all devices will stop much faster than in previous versions. In addition, your Skype chat history and read messages will automatically sync across all your devices, as well, so no matter where you are or what you're doing, you are up-to-date.

www.skype.com

DRIVER BAY

Intel Iris & HD Graphics 15.33.14.64.3412

This driver update adds support for Intel Quick Sync Video on select 3rd and 4th Generation Pentium and Celeron processors with Intel Iris and HD Graphics. After you install the upgrade, you should notice enhanced quality for video conferencing and video capture. The 15.33.14.64.3412 update also delivers a performance boost for OpenGL-based video games and applications. New OpenGL support increases the maximum number of texture image units to 32. Intel offers both 32- and 64-bit versions of the driver.

downloadcenter.intel.com

NVIDIA 334.16 Linux Display Driver

NVIDIA has released a beta version of its 334.16 Linux driver that adds 64-bit EGL and OpenGL ES support to an enormous list of desktop and notebook GeForce GPUs as well as the company's Quadro and ION products. There are also a number of big fixes in this release. For instance, 334.16 updates the NVIDIA Control Panel to allow the selection of display drivers using RandR and target ID names. It also changes the display driver's default behavior to stop deleting RandR 1.2 outputs corresponding to unused DisplayPort 1.2 devices. (A new option is available to turn this behavior back on, should you need to.)

www.nvidia.com/drivers

Connected Cars Hit The Road

New Tech Is Coming Soon To A Vehicle Near You

The Internet is readily available in most places when we need it. In the modern home and office, online connectivity is a given, and smartphones have made it possible to access the web when you're on the go. But there's one place where smartphone use isn't convenient and often dangerous—your vehicle. The connected car is the next frontier when it comes to broadband Internet access, and a number of automotive manufacturers have recently announced web-based features for future lineups. Here, we'll examine the ways network connectivity might be integrated into your next vehicle.

Overcoming Car Constraints

Obviously, any application that's integrated into a vehicle must be designed so that it doesn't distract the driver. As such, connected features need to provide timely, actionable information or data on demand without physical input from the driver. It's a much different experience than what you've come to expect from a smartphone or tablet. According to tech research firm Gartner, "It's not about Internet browsing in the car and instead about Internet snacking. That means getting the right amount of information contextualized at the right time." For instance, some examples of quick, practical features could be an alert about an upcoming traffic jam displayed in the vehicle's instrument cluster, the ability to select an Internet radio station via voice command, or a vehicle's capability to read text messages aloud.

General Motors' AppShop already has a budding lineup of car-optimized apps.

Embedded connectivity has been around since General Motors' launched its OnStar service in 1996, but the ability to affordably incorporate high-speed mobile broadband changes what car manufacturers can do. At this year's CES, General Motors announced its AppShop and built-in LTE connectivity for select 2015 Chevrolet models with MyLink technology. From the MyLink screen, you'll be able to view the available apps and download them to your vehicle. Chevrolet indicated that the apps will let you connect with things like online music, news, weather, travel information services, and current vehicle data.

Imagine the benefits of a car that could self-diagnose a problem, inform you of the nearest repair shop, and let you schedule a dealer service appointment though the dash. Thilo Koslowski, vice president and distinguished analyst at Gartner, says, "What we're seeing now is that some car manufacturers are beginning to really think about how they can create completely different experiences in the car that are connected and Internet-enabled. The features go beyond the radio streaming and location-based services of the past."

Commanding Your Vehicle

For drivers to effectively take advantage of connected features, car manufacturers must further develop the way we issue commands to a vehicle. Automotive designers call this process HMI (human machine interface). Currently, most connected car implementations utilize a mix of voice and dashboard controls, but future HMI designs could be very different.

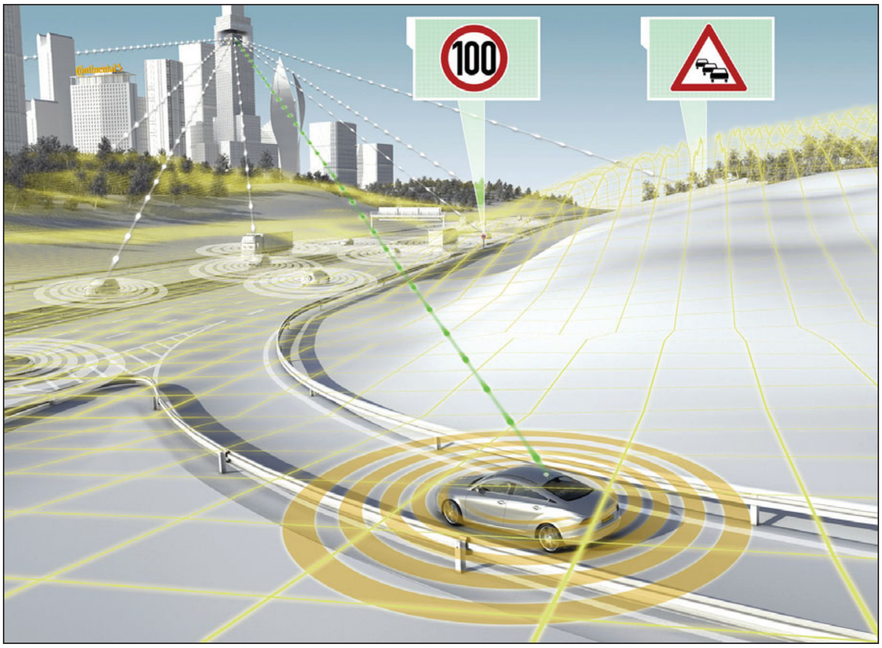
"It's going to be a combination of all kinds of user interface technology, such as haptic feedback and gesture recognition," says Koslowski. For instance, cameras inside the car can be used to monitor your hand and finger gestures, so a physical cue could tell the car to skip a song, bring up the next turn in a selected route, or turn on voice recognition. Voice commands are one area where app developers will likely have control of what you'll need to say to activate a given feature. It will be up to the app developers to come up with voice commands that are easy to remember while you're busy driving the car.

> Various applications enabled by V2V technology could provide significant benefits with respect to crash reduction.
>
> -Nathan Naylor, NHTSA communications director

Advanced driver assistance commands will likely be used in conjunction with the traditional dashboard controls. "Physical buttons will also be key, because in a vehicle environment you can repeat muscle memory and know that a certain function will operate when you press a button," says Koslowski. "With physical buttons, you'll also receive feedback that you've actually pressed the button—that's unbeatable."

When it comes to future HMI tech, car companies are testing a lot of different implementations. Dominique Bonte, vice president and practice director at ABI Research, says, "Both gesture control and the use of eye movement/focus are being actively explored by companies such as Visteon and Continental AG. Audi has showcased its next-generation user interface and predictive user experience approach." Continental is taking what it calls a holistic approach to HMI. For example, interior cameras can monitor the driver's head and viewing angle, and if there's a danger the driver might not see, the car can activate accoustic and haptic warnings that alert him to the problem.

Some HMI methods may even be able to anticipate drivers' needs based on driving conditions. "The vehicle could detect if you're occupied or in a stressful situation and react on your behalf. This could include simple things, such as changing the [interior] lighting color based on your stress," says Koslowski. The car's electronics could also recognize when you're particularly focused on the task at hand. Let's say that you're driving fast and passing vehicles on the highway. In this situation, the car could direct phone calls straight to voicemail.



Connectivity within the vehicle could allow your car to alert you of upcoming traffic delays or dangers.

A New Battleground For Google & Apple

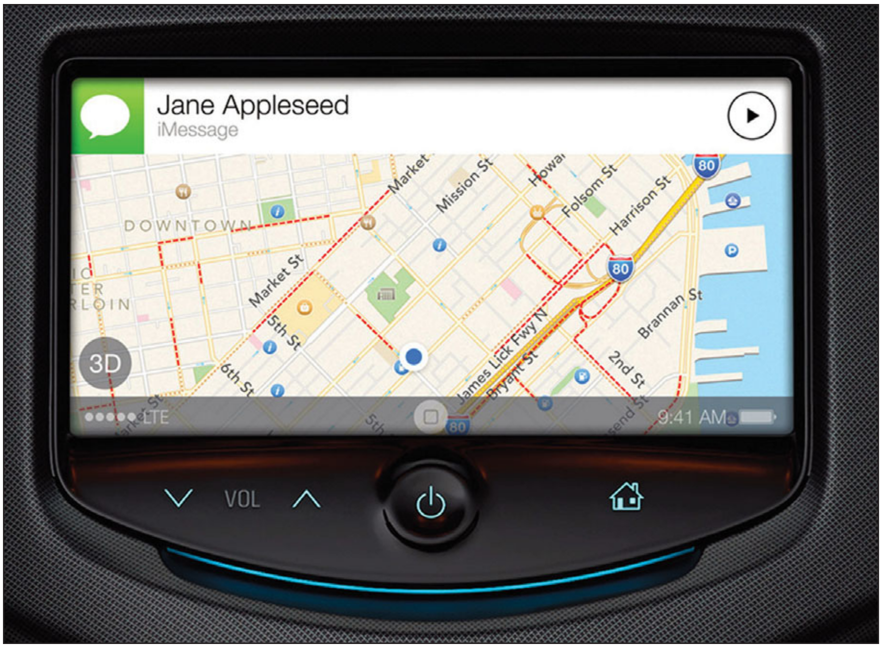
Both Google and Apple have announced platforms that will allow the companies to work directly with car manufacturers to improve connectivity. Apple's initiative is CarPlay (formerly iOS in the Car), and it will allow you access to and control over navigation, messages, calls, and music through a vehicle's in-dash display. For instance, CarPlay can remember when you leave for home or work and display traffic conditions along your route. The car's onboard controls will also let you manage iTunes Radio, podcasts, and third-party audio apps. CarPlay works with iPhone 5/5C/5S smartphones. At WWDC (Worldwide Developers Conference) 2013, Apple announced partnerships with Honda, Mercedes-Benz, Nissan, Volvo, and Chevrolet, among others.

Google moved into the connected car market by establishing the Open Automotive Alliance. "The OAA is aimed at fostering Android mobile devices and ecosystems in the car, as well as new features to facilitate the use of Android as an embedded vehicle OS," Bonte says. The car manfacturers that have joined the OAA currently include Audi, General Motors, Honda, and Hyundai.

From the technology side, Google has partnered with NVIDIA, which suggests that upcoming connected cars might include Tegra mobile processors. NVIDIA recently announced its Tegra K1 mobile processor that's designed to bring advanced computational capabilities to the car. The Tegra K1 is certainly a powerful little chip, as it offers a quad-core CPU and a 192-core GPU that features the company's Kepler architecture. Just some of the capabilities Tegra K1 can power include pedestrian detection, blind-spot monitoring, lane-departure warning, and street sign recognition.

The OAA's website indicates that the group's partners are working toward better integration between cars and Android devices, as well as improving how the car itself can be an Android device. As such, a connected car might have Android technology built into a proprietary dashboard system.

Because both CarPlay and the OAA are still under development, we could see massive changes to both Apple's and Google's final products. "What comes next, such as things like Google Now and other functionality, has yet to be seen," says Koslowski. "Car manufacturers may also have difficulty handing over that much control to a technology company."



Connected cars that support Apple's CarPlay can sync with your iPhone and allow for control through the dashboard.

Google's established the Open Automotive Alliance to spread its Android platform to the car.

Car Phone 2.0

Some car manufacturers have already created ways to utilize your mobile device with your vehicle. For instance, Ford's SYNC AppLink connects to your smartphone through Bluetooth (for Android and BlackBerry devices) or USB (for iPhones). You can control apps through voice commands or the vehicle's dashboard. SYNC AppLink only works with apps that have been certified as SYNC AppLink-compatible. You can find an entire list at support.ford.com/sync-technology/applink-overview-sync. Some examples of popular Android applications include Amazon Cloud Player, AT&T Navigator, iHeartAuto, Pandora, Scout by Telenav, and Slacker Personal Radio. With the iPhone, you can give commands to MLB.com At Bat, NPR News, Pandora, Spotify, and USA TODAY, among others.

Ford's SYNC AppLink connects your smartphone to your car and works with both Android, BlackBerry, and iOS smartphones.

To command Ford SYNC AppLink, you'd just press the Voice button on the steering wheel and say, "Mobile apps." Next, SYNC will respond, "Mobile apps, please say a command." From here, you can just say the name of the app you want to operate. Voice commands vary by application, so you'll need to follow each app's instructions to figure out what you'll need to say. The platform-agnostic design lets Ford easily incorporate smartphone connectivity with its new vehicles. And your choice of compatible smartphones won't be as limited with a Ford SYNC-enabled vehicle. All consumer models in Ford's 2014 lineup are compatible with SYNC AppLink.

"Automotive app stores are quickly becoming mainstream, with GM OnStar announcing its AppShop, Ford extending AppLink, and all other car OEMs showcasing their apps approach at CES 2014," says Bonte. Another example of smartphone integration in automobiles is Jaguar Land Rover's InControl Apps. The first wave of apps for InControl include iHeart Radio, Stitcher, Glympse, Parokpedia, Cityseeker, and AirMotion News. InControl Apps can run on Android or Apple smartphones, and InControl can transfer the app's interface to the in-car touchcscreen.

In the future, app designers will likely be working in hand in hand with car manufacturers to implement the technology in a way that works best. One such method could be HTML5. Bonte says, "HTML5 apps are gaining momentum, with Abalta Technologies and Delphi showing a low-cost head unit implementation, while Mazda announced a partnership with OpenCar for tools to facilitate HTML5 application development, optimization, and branding." TeleNav has also recently showcased an HTML5 navigation app. Similar to the initiatives from Apple and Google, these are some of the first HTML5 apps to be developed for the car.

Complete Car Integration

Embedding smartphone connectivity within cars is one way to quickly add online features to current vehicle lineups, but the end goal is to make the car part of everyone's networked devices. "The connected car is ultimately about the Internet of cars, which can make it part of the Internet of things," Koslowski says.

With a majority of vehicles connected to the same network, smartphones and automobiles will work together to provide more than just entertainment. "You can use the technology to optimize traffic flow, such as telling people when they should leave a destination to make it on time for a meeting or to get home," says Koslowski. "The car can be working with other online data and your devices before you even get into the vehicle."

We're starting to see some of these features with new connected vehicles. For instance, General Motors' AppShop offers Glympse, an app that allows a driver to temporarily share her real-time location with others, and she may also share things like her current speed and estimated arrival time. The AppShop's The Weather Channel app displays visual and audible weather information for the current conditions along your route. With these types of connected apps, car manufacturers can enhance the driving experience without requiring drivers to take their eyes off the road.

The convergence of consumer electronics with cars can let vehicles work with the connected home, as well. For instance, Mercedes-Benz will be adding support for Nest's popular connected thermostats to let you remotely control house temperature from your vehicle. This functionality will be built into the Mercedes-Benz Digital DriveStyle smartphone app, which can work with Mercedes-Benz models equipped with Drive Kit Plus. Ford recently announced its MyEnergi Lifestyle, which is a collaboration with Eaton, Infineon, SunPower, and Whirlpool. The initiative showcases how Ford's Fusion Energi plug-in hybrid vehicles can schedule and control electric vehicle charging to reduce demand.

Cars Connecting With Each Other

Safety features are among the most important in any car, and advancements in environmental sensors, electronics, and connectivity make it possible to significantly improve vehicle safety. The United States National Highway Traffic Safety Administration is working on integrating V2V (vehicle-to-vehicle) communication into future cars. With V2V, cars broadcast a BSM (basic safety message) with safety-related information, such as speed and location, 10 times per second. Your vehicle can receive this information and analyze the data to see if you're at risk.

Recently, the NHTSA performed a real-world test of V2V with nearly 3,000 vehicles in Ann Arbor, Mich. NHTSA communications director Nathan Naylor says, "Our research indicates that various applications enabled by V2V technology could provide significant benefits with respect to crash reduction." For those concerned about privacy, V2V will not involve exchanging or recording personal information or tracking your car's movement. "The information sent between vehicles does not identify those vehicles, but merely contains basic safety data," Naylor says.

V2V can improve more than vehicle safety. "We believe future applications will be developed that could lead to reduced congestion and improved mobility," Naylor says.

Automotive supplier Continental is currently working with IBM to find ways for vehicle electronics to improve the safety, economy, and comfort of driving. In a January press release, Continental explained, "In the future, the Connected Electronic Horizon will add sensor data from networked vehicles to static card data." The information could allow cars to "see" where you can't, as well as collect data that all connected vehicles could access in real time. "The car could . . . tell you things like when a stop light is changing or the speed you will need to maintain to have a smooth, continuous drive," says Koslowski.

Technology in the car may also help to detect motorcyclists and pedestrians. Continental has begun installing a stereo camera system (two high-resolution CMOS cameras) that can measure distances to road obstructions, such as pedestrians, and apply an emergency brake to avoid an accident. Honda also recently announced that it has been researching V2P (vehicle-to-pedestrian) and V2M (vehicle-to-motorcycle) technologies that will help protect everyone on the roadway. Honda recently introduced a Forward Collision Warning system on Honda and Acura models that uses a camera behind the windshield to warn you of potential collisions.

The NHTSA is working on a regulatory proposal to require V2V devices in future vehicles, but it will take time to draft a proposal consistent with existing legal requirements, executive orders, and so forth. The agency hasn't established an ideal year that should be used a start date, but Naylor says "the timing of implementation will be informed by the comments we receive on our research report and additional information we receive as we pursue a regulation." If V2V-enabled cars can communicate with a larger traffic network, all the vehicles could function as a crowd-sourced network with real-time traffic data. The electronics inside your car could analyze the speeds and traffic congestion on your various routes to determine which one is the most efficient to reach your destination.

Are We There Yet?

The next generation of vehicles will be a good barometer of how well car manufacturers have been able to integrate online connectivity with HMI controls that let you keep your eyes on the road. There are lot of potential hang-ups that could delay adoption, including government safety regulations and conflicts between technology companies and car manufacturers. At the very least, the initial wave of connected cars will include several popular entertainment apps found on smartphones and tablets. Already available in cars and on phones, navigation tools should be greatly improved, too. Cars may not be driving themselves anytime soon, but if you're in the market for a new vehicle, it would certainly be smart to pay attention to what types of connected car capabilities are available. ■

Future Mercedes-Benz vehicles will let you remotely control a Nest smart thermostat from your car, so you can adjust your home's temperature when you're away.

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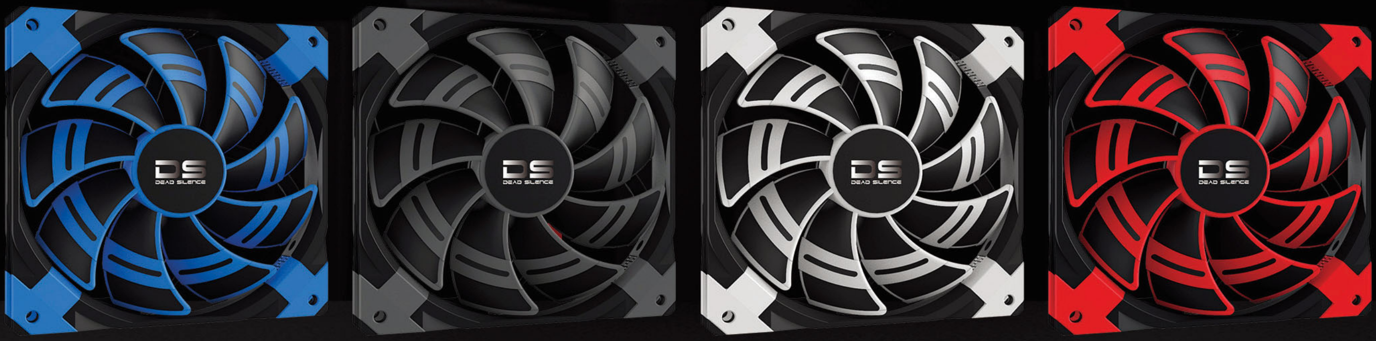

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Q&A With JR Munoz

Streak Products' VP On ULTRA

Q: Many of our readers are familiar with the ULTRA brand, but probably fewer are aware of Streak Products. Can you tell us more about Streak and how it's related to ULTRA?

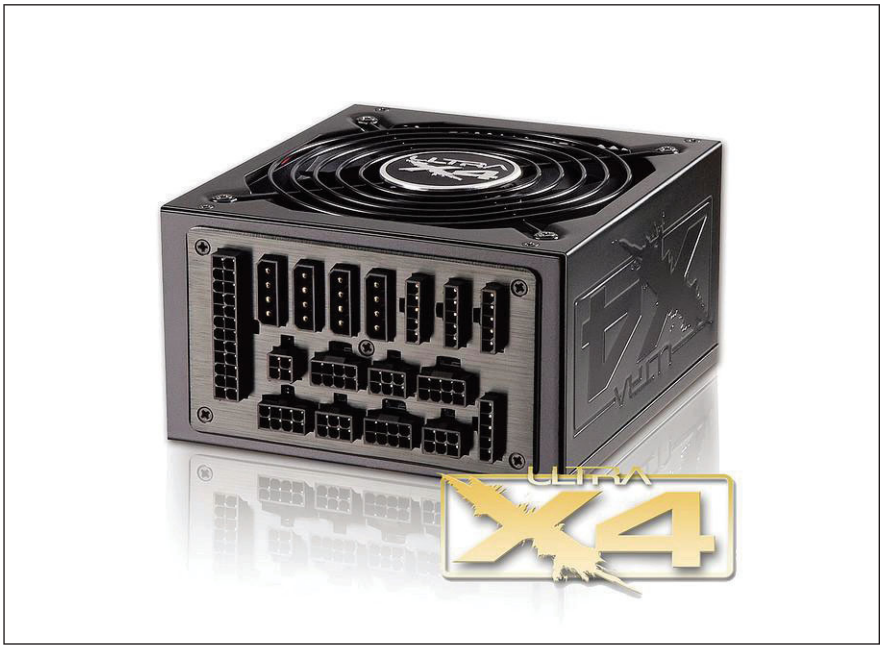
JRM: A lot of the most familiar brands in the industry are owned by parent companies that you may have never heard of. The logic behind this is that the parent company will often own several differentiated companies/brands and take them to market in unique ways pertinent to the categories they compete in. The advantage for Streak is that we can combine our expertise in completely unrelated markets and bring them together into innovative products that better satisfy consumer needs.

Q: Are there other brands under the Streak Products umbrella that *CPU* readers should keep an eye on, and if so, what kinds of products do/will they specialize in?

JRM: Yes, there are. Eastwear designs computer bags, tablet covers, notebook cases and messenger cases, and soon will offer TSA-approved luggage, accessories, and apparel. Color Research has been hard at work expanding its complete portfolio of consumable products to cover 85% of the market's needs in ink and toner. They also have a full line of blank media ranging from blank DVDs to Blu-ray Discs, air dusters, and cleaning supplies. Interion offers hardware for the office or any interior space, including chairs, desks, mounts, stands, boards, and more. INVEO, born from the words "video innovations," offers CE devices with style. ULTRA, our most widely known brand, continues to be our flagship company covering hundreds of items. ULTRA's primary focus is in computer cases, accessories, and power supplies, as well as UPSes and cables.

ULTRA Etorque A5

Q: We remember ULTRA's X-Connect power supplies. Are your new X-4 Series PSUs the fourth evolution of the old X-Connect line? Can you talk about ULTRA's design philosophy where PSUs are concerned? For instance, what is the X4's best feature, and why?



ULTRA's X4 Series fully modular PSU

JRM: For nearly 22 years, we've been a leader in the PC power business. Our X4 modular power supplies are the latest version of our best-selling line of modular PSUs. ULTRA X-Series PSUs go back several generations and are well known amongst gaming enthusiasts. This generation is better than ever. X4 Series features an 80% efficiency rating, so less energy is wasted when running your fully rigged machine on all cylinders. Choose only the cables you need—and with the included bag, VELCRO straps, zip ties, and vibration gasket, you get cable management and unencumbered airflow as well as ultra-quiet operation.

We overbuild our X4s and overpack them with everything you need and more. Our customers care about what they buy when they build their rigs, and we care enough to pay attention to the details because when you need to replace that unit or upgrade, you'll come back to us.

Q: What's the elevator pitch for Ultra X4 Series power supplies vs. others in the market right now?

JRM: X4 PSUs are fully modular not semi-modular. Our competitors market theirs as "modular" PSUs even when they have embedded cables. Our semi-modular PSUs are labeled under our new lineup of Hybrid Series or HS PSUs. In addition, our products are stringently tested with exacting standards, and we simply don't sacrifice quality over cost. We can't say that for many of our competitors.

Q: ULTRA's website lists a few product categories that do not yet include product info. Do you have more items coming, and when will we start to see those categories fill up?

JRM: ULTRA is aggressively growing its lineup of products into networking, surveillance, home automation, and memory.

Q: Thanks for your time today. Before we let you go, can you tell *CPU* readers something about ULTRA Products that they might not know?

JRM: ULTRA is the original inventor of the modular power supply and holds the technology patent. This is the standard used throughout the industry, and we pioneered it. ■

ULTRA Etorque X10

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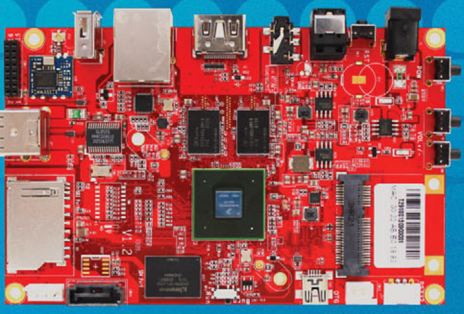

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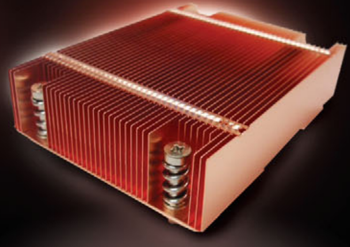

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Q&A With Bennett Yang

ADATA's SSD Product Manager On The Premier Pro SP920 Series

Q: We just received our first review unit from ADATA's new Premier Pro SP920 family of SSDs. What kind of user and what types of applications are these drives designed for?

BY: The Premier Pro SP920 series 2.5-inch SSD is designed to meet the high-performance requirements of multimedia file transfers. It is especially strong when dealing with high-resolution (uncompressed) video data.

Q: Our drive was a 256GB model; can you tell us what other capacities will be available in the series?

BY: SP920 Series drives will also be available in 128GB, 512GB, and 1TB capacities.

Q: What kind of performance numbers should we expect from the SP920?

BY: We have numbers from several benchmarks on the SP920 drives. Running the ATTO Disk Benchmark, we reached sequential read speeds of 560MBps on all capacities, with write speeds coming in at 500MBps (the 512GB and 1TB models), 360MBps (256GB), and 180MBps (128GB model). In AS SSD, the drives scored sequential reads of 510MBps (512GB, 1TB) and 520MBps (128GB, 256GB), and sequential writes up to 470MBps (512GB and 1TB models), 340MBps (256MB), and 180MBps (128GB).

In CrystalDiskMark, we saw sequential reads up to 520MBps (128GB and 256GB) and 510MBps (512GB, 1TB), and sequential writes up to 480MBps (1TB), 470MBps (512GB), 360GB (256GB), and 180MBps (128GB). The SP920's Iometer results were equally impressive, with 4K random reads up to 98,000 IOPS (512GB and 1TB; 96,000 IOPS from the 256GB drive and 80,000 IOPS from the 128GB unit) and 4K random writes up to 88,000 IOPS (512GB and 1TB; 80,000 IOPS from the 256GB drive and 45,000 IOPS from the 128GB drive).

Q: What kind of NAND do these drives use?

BY: We use Micron 20nm L85A NAND flash.

Q: What kind of controller and firmware did you choose for the SP920s, and why?

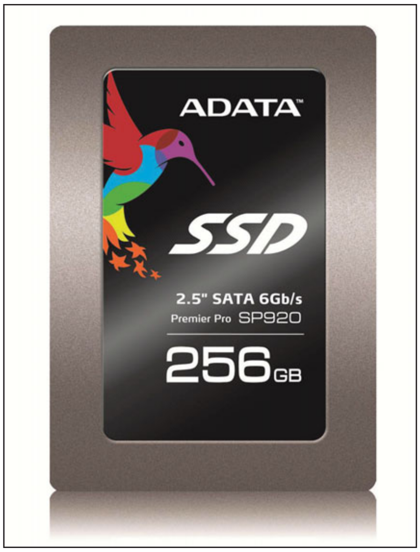
BY: We provide the latest Marvell 88SS9189 controller to provide the best performance, and we updated all of the firmware to improve performance for different kinds of use. Of course, ADATA will continue to improve firmware quality and reliability for various usage types over time.

Q: The information we received initially suggests that the SP920 will provide users with 7% more usable space vs. many current models. How does the drive do this?

BY: It is an expanded-capacity solid-state drive that uses new firmware optimized to use more storage capacity from the NAND flash components.

Q: What MSRP will the SP920 drives have at launch?

BY: The 128GB has an MSRP of $89.99, the 256GB unit is $159.99, the 512GB drive will sell for $334.99, and the 1TB SP920's MRSP will be $529.99.



Q: Thanks for your time today. Is there anything else about the Premier Pro SP920 that you'd like to mention?

BY: First, some SSDs suffer a performance drop as they near their capacity in terms of data stored. Our ADATA Premier Pro SP920 maintains consistently high read and write speeds even when the disk is 90% full. Also, SP920 users will now have even more power at their fingertips with the recent release of ADATA's proprietary SSD ToolBox software. SSD ToolBox provides multiple ways for users to obtain disk information, change settings, and improve SSD life span and performance. Combined with the known advantages of solid state and ADATA's expertise in this area, the Premier Pro SP920 SSD is shaping up as an ideal SSD solution in terms of performance, data security, and stability. ■

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